STAR

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Index Table 3—

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INTRODUCTION

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Volume 9 Number 11 / June 8, 1971

TABLE OF CONTENTS

Subject Categories

Abstracts in the journal are grouped under the following categories: page

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbomachinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion. **1669**

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics. **1671**

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems. **1677**

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology. **1678**

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences. **1686**

06 CHEMISTRY

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07 COMMUNICATIONS

Includes communications equipment and techniques; noise; ratio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation. **1698**

08 COMPUTERS

Includes computer operation and programming; and data processing. For applications, see specific categories. For related information see also: 19 Mathematics. **1715**

09 ELECTRONIC EQUIPMENT
Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation. **1722**

10 ELECTRONICS
Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see specific Physics categories. **1727**

11 FACILITIES, RESEARCH AND SUPPORT
Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations. **1730**

12 FLUID MECHANICS
Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences. **1733**

13 GEOPHYSICS
Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences. **1743**

14 INSTRUMENTATION AND PHOTOGRAPHY
Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras. **1760**

15 MACHINE ELEMENTS AND PROCESSES
Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control; reliability; drafting; and materials fabrication, handling, and inspection. **1767**

16 MASERS
Includes applications of masers and lasers. For basic research see: 26 Physics, Solid-State. **1774**

17 MATERIALS, METALLIC
Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics. **1776**

18 MATERIALS, NONMETALLIC
Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics. **1781**

19 MATHEMATICS
Includes calculation methods and theory; and numerical analysis. For applications see specific categories. For related information see also: 08 Computers. **1786**

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences. 1788

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications. 1791

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related Information see also: 03 Auxiliary Systems; and 28 Propulsion Systems. 1793

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics, 20 Meteorology, and 29 Space Radiation. 1796

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation. 1800

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems. 1810

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics. 1814

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems. 1819

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants. 1820

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics, and 24 Physics, Atomic, Molecular, and Nuclear. 1822

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbits and trajectories. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles. 1824

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics. **1830**

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic. **1833**

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants. **1839**

34 GENERAL

Includes information of a broad nature related to industrial applications and technology, and to basic research; defense aspects; information retrieval; management; law and related legal matters; and legislative hearings and documents. **1845**

SUBJECT INDEX I-1

PERSONAL AUTHOR INDEX I-65

CORPORATE SOURCE INDEX I-71

CONTRACT NUMBER INDEX I-87

REPORT/ACCESSION NUMBER INDEX I-91

ACCESSION/REPORT NUMBER INDEX I-101

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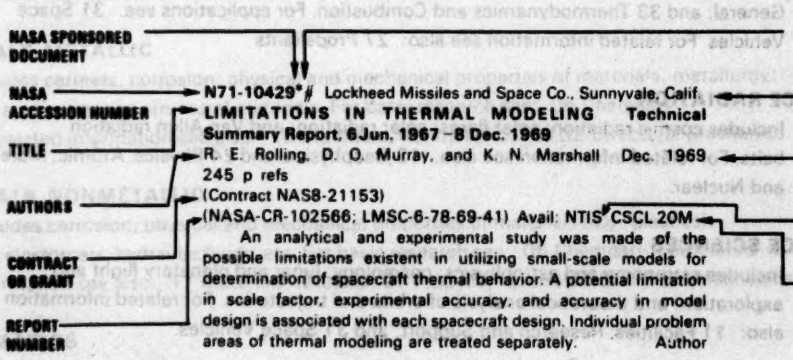
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An analytical and experimental study was made of the possible limitations existent in utilizing small-scale models for determination of spacecraft thermal behavior. A potential limitation in scale factor, experimental accuracy, and accuracy in model design is associated with each spacecraft design. Individual problem areas of thermal modeling are treated separately. Author
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VOLUME 9 NUMBER 11 / JUNE 8, 1971

Scientific and Technical Aerospace Reports

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01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N71-21961*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A WIND-TUNNEL INVESTIGATION OF SONIC-BOOM PRESSURE DISTRIBUTIONS OF BODIES OF REVOLUTION AT MACH 2.96, 3.83, AND 4.63

Barrett L. Shrout, Robert J. Mack, and Samuel M. Dollyhigh Washington Apr. 1971 33 p refs

(NASA-TN-D-6195; L-7398) Avail: NTIS CSCL 01A

Sonic-boom pressure signature measurements were made for a series of bodies of revolution at Mach numbers of 2.96, 3.83, and 4.63. Maximum overpressure and signature impulse tend to increase with increasing Mach number as predicted by a near-field modified linear theory applicable to smooth bodies. However, the measured signatures agree only qualitatively with near-field theory at the high Mach numbers. Inclusion in the theory of the effects of oblique-plane-surface forces and model boundary layer improved the correlation between theory and experiment. A nonsmooth-body theory produced better agreement for the trailing shock but with some reduction of the signature impulse. Author

N71-21973*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

CHARTS FOR PREDICTING THE SUBSONIC VORTEX-LIFT CHARACTERISTICS OF ARROW, DELTA, AND DIAMOND WINGS

Edward C. Polhamus Washington Apr. 1971 11 p refs

(NASA-TN-D-6243; L-7558) Avail: NTIS CSCL 01A

The leading edge suction analogy method of predicting the aerodynamic characteristics of slender delta wings was extended to cover arrow and diamond wing planforms. Charts for use in calculating the potential and vortex flow terms for the lift and drag are presented, and a subsonic compressibility correction procedure based on the Prandtl-Glauert transformation is outlined. Author

N71-22068*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

ANALYSIS OF EFFECTS OF SPANWISE VARIATIONS OF GUST VELOCITY ON A VANE-CONTROLLED GUST-ALLEVIATION SYSTEM

L. Keith Barker and Gene W. Sparrow Washington Apr. 1971 28 p refs

(NASA-TN-D-6126; L-7442) Avail: NTIS CSCL 01A

An analysis was made of the effects of spanwise variations of gust velocity in isotropic turbulence on a gust-alleviation system which employs an angle-of-attack vane mounted ahead of the wing to sense the vertical gust velocity. The wing flaps were moved in response to the vane deflection by a linear second-order servosystem to produce a lift opposite to that produced by the gust. Consideration of spanwise variation of gusts has indicated design parameters (gain and natural frequency of flap servosystem and vane location) that give substantial reduction of the lift due to gusts. Author

N71-22070# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Berlin (West Germany). Abteilung Aeroakustik und Instabilitaet.

A WAVE MODEL FOR SOUND GENERATION IN CIRCULAR JETS

Alfons Michalke Nov. 1970 33 p refs

(DLR-FB-70-57) Avail: NTIS; ZLDI Munich: 9,30 DM

A wave model is used for the investigation of sound generation in circular jets. The source term of the Lighthill equation is expressed by a Fourier series in the azimuthal angle, is Fourier-transformed with respect to time, and each component is assumed to be of wave-type in jet direction. A far-field solution for the sound pressure is derived for single azimuth-frequency components. It is found that the sound field depends strongly on a convection parameter and on a jet thickness parameter. The influence of axisymmetric and azimuthal source components is discussed. For a special source term with arbitrarily chosen amplitude distributions the convection factor and the jet thickness factor of sound intensity are calculated and discussed. The influence of the amplitude distribution of the source components is found to be of minor importance. Author (ESRO)

N71-22098# Naval Ship Research and Development Center, Washington, D.C. Dept. of Aerodynamics.

APPLICATION OF THE METHOD OF INTEGRAL RELATIONS (MIR) TO TRANSONIC AIRFOIL PROBLEMS. PART 1: INVISCID SUPERCRITICAL FLOW OVER SYMMETRIC AIRFOILS AT ZERO ANGLE OF ATTACK

Tsze C. Tai Sep. 1970 42 p refs

(AD-717339; NSRDC-3424; Aero-1176) Avail: NTIS CSCL 20/4

The feasibility of applying the method of integral relations (MIR) to transonic flows over symmetric airfoils was studied. In order to take account of the severe transversal flow variation and still retain simplicity in computation, the method is modified so that the number of strips used may be considerably higher than the order of the polynomial which approximates the integrand. An important feature of this modification, however, is its capability to extend the free-stream boundary to infinity. Using one-strip and two-strip approximations, flow equations are reduced to a set of ordinary differential equations in a cartesian coordinate system.

Numerical procedures, including the treatment of the sonic point and the determination of shock location, are also formulated. The fourth-order Runge-Kutta method was used in numerical computation. The advantage of small computer capacity and time required by the method is evidenced by exploratory calculations for a symmetric circular-arc airfoil and an NACA 0012 airfoil, traveling at supercritical speeds. It is also found that in transonic airfoil problems using a cartesian coordinate system, the order of polynomial approximating the integrand in the method of integral relations should be at least second-order or higher. Author (GRA)

N71-22159# National Aerospace Lab., Tokyo (Japan).
CYLINDRICAL BOUNDARY INTERFERENCE ON VIRTUAL MASS OF A SPHERE
Nagamasa Kono Nov. 1970 17 p refs In JAPANESE; ENGLISH summary
(NAL-TR-223) Avail: NTIS

In order to clarify the virtual mass increment by cylindrical wall interference the flow field induced by a single doublet located at an arbitrary point in a cylinder and having its axis oriented parallel to the axial and radial direction and normal to both directions was solved, and closed surfaces were sought by transforming the field to an uniformly translating system. The virtual mass was calculated from the kinetic energy and results were compared with the case of a free field. When a body is placed on the cylinder axis, boundary interference appears both as surface distortion and virtual mass increase: the former is not serious unless the radius ratio of the body to the clyinder does not exceed 0.5, but the latter is remarkable. Results when the body is off-centered at 0.3 radius from the cylinder axis showed complex behavior depending on the orientation of motion. Author

N71-22160# National Aerospace Lab., Tokyo (Japan).
AERODYNAMIC CHARACTERISTICS OF A FLARED BODY WITH BLUNT NOSE
Takashi Tani, Iwao Kawamoto, Seizo Sekakibara, Junichi Noda, and Hiroshi Higuchi Oct. 1970 17 p refs In JAPANESE; ENGLISH summary
(NAL-TR-221) Avail: NTIS

The aerodynamic characteristics of a flared body with blunt nose were investigated theoretically and compared with the result of experiments conducted in a supersonic wind tunnel at Mach numbers 2 and 3. Measurements of the static pressure, as well as the total pressure, around the blunt nosed body immediately revealed that the blunt nose caused a strong shear flow field in the vicinity of the body surface and that the pressure distribution measured on the flare of the blunt body was markedly different from that of a similar body with sharp nose. Analysis based on the concept of two parallel layers which approximated the shear region showed the pressure distribution to be quite acceptable in simulating the experimental distribution for the flare due to a blunt nosed body. Author

N71-22300# ARO, Inc., Arnold Air Force Station, Tenn.
INVESTIGATION OF BLUNT FIN-INDUCED FLOW SEPARATION REGION ON A FLAT PLATE AT MACH NUMBERS 2.5 TO 4.0 Final Report
Ernest J. Lucas AEDC Jan. 1971 25 p refs
(Contract F40600-71-C-0002)
(AD-717717; AEDC-TR-70-265) Avail: NTIS CSCL 20/4

Tests were conducted at Mach numbers 2.5 to 4.0 to investigate the effects of cylindrically blunted fins on the flow over a flat plate at zero angle of attack. The free-stream Reynolds number, based on the distance from the blunt fin to the flat plate leading edge, ranged from 2,800,000 to 4,700,000. Pitot pressure profiles were obtained in the fin-induced flow separation region. Increasing the thickness of the fin was found to increase the size of the three dimensional separation area. Pressure distributions as well as examples of the oil flow and schlieren photographic coverage are presented. Author (GRA)

N71-22374# Cambridge Univ. (England). Dept. of Engineering.
EXPERIMENTAL PRESSURE DISTRIBUTIONS ON AEROFOILS IN TRANSVERSE AND STREAMWISE GUSTS
D. W. Holmes 1970 38 p refs
(CUED/A-Turbo/TR-21) Avail: NTIS

Experiments are described in which measurements were made of the force and pressure fluctuations on an aerofoil in an unsteady flow. Two types of unsteady flow are studied: (1) a transverse gust flow and (2) a streamwise gust flow. In both cases the gust was non convective and had a propagation speed that was less than the mean flow velocity. All the experiments were performed with a low reduced frequency, the maximum value reached being 0.2 based upon the half chord. The streamwise gust results are presented to show separately the responses due to incidence and thickness. For the transverse gust flow a detailed picture is presented of the pressure fluctuation in the trailing edge region and results are also presented demonstrating the effect of incidence. It is further shown for both flows that the form of the lift fluctuation due to a harmonic gust is also harmonic to a small approximation. Author

N71-22472# National Aeronautical Lab., Bangalore (India).
SOME REMARKS ON MULTHOPP'S SUBSONIC LIFTING-SURFACE THEORY
P. Ramamoorthy Mar. 1970 12 p refs
(NAL-TN-24) Avail: NTIS

Multhopp's subsonic lifting surface theory, introducing interpolation functions to facilitate the integration in the spanwise direction, is reviewed. The interpolation functions were derived, using the least square approximation. Author

N71-22568*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPUTER PROGRAM DESCRIBING TURBINE AERODYNAMIC REQUIREMENTS, APPROXIMATE EXTERNAL BLADE GEOMETRIES, AND COOLANT FLOW REQUIREMENTS FOR A TWO STAGE AXIAL FLOW TURBINE
Keith A. Furgalus, David G. Evans, and Michael R. Vanco Washington Apr. 1971 59 p refs
(NASA-TM-X-2229; E-6014) Avail: NTIS CSCL 21E

A computer code is described which generates aerodynamic and thermodynamic designs for a two-stage cooled or uncooled axial-flow turbine. A free vortex flow model is used to generate hub, mean, and tip velocity diagrams. From these diagrams, inner-stage temperatures and pressures, approximate external blade shapes, external blade surface areas, and turbine blade and wall coolant airflow requirements are computed. Inner-stage temperatures and turbine annulus areas are adjusted to include the effects of the mass flow and energy addition of the blade cooling air. Author

N71-22569*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CALCULATION BY A FINITE DIFFERENCE METHOD OF SUPERSONIC TURBULENT BOUNDARY LAYERS WITH TANGENTIAL SLOT INJECTION
Ivan E. Beckwith and Dennis M. Bushnell Washington Apr. 1970 75 p refs
(NASA-TN-D-6221; L-7515) Avail: NTIS CSCL 20D

A method based on eddy-diffusivity and mixing-length concepts was developed for calculating turbulent boundary layers with

tangential slot injection. The partial differential equations for the mean motion are solved by a finite-difference procedure. Comparisons of predicted velocity profiles, boundary-layer thicknesses, heat transfer, skin friction, and recovery temperatures were made with experimental data from previous investigations at free-stream Mach numbers of 3 and 6. Prediction and experiment showed good agreement over the range of conditions and locations available, including just downstream of the slot where maximum reductions in skin friction occurred. Details of the mixing-length relations and computer program are included. Author

N71-22622*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SUBSONIC AERODYNAMIC CHARACTERISTICS OF A HIGHLY SWEPT FIXED WING CONFIGURATION WITH VARIATION IN WING DIHEDRAL ANGLE
William P. Henderson Washington Apr. 1971 45 p refs
(NASA-TM-X-2261; L-7473) Avail: NTIS CSCL 01A

An investigation to determine the effects of wing-dihedral angle on the aerodynamic characteristics of a highly swept fixed-wing configuration was conducted. The tests were conducted at a Mach number of 0.168, at angles of attack of −5 deg to 22 deg, and at sideslip angles of 0 deg and + or − 5 deg. The effects of the addition of vertical tails, vertical-tail cant angle, and leading-edge flap deflection on the aerodynamic characteristics are also included. Author

N71-22666 Iowa State Univ. of Science and Technology, Ames.
NATURAL FREQUENCIES OF VIBRATION OF A TRIANGULAR INFLATABLE WING MODEL
Lo-Ching Hua (Ph.D. Thesis) 1969 136 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 70-7705

The influence coefficients, natural frequencies and mode shapes of vibration of a triangular inflatable wing are computed. The influence coefficients of the wing are computed by two different methods. The first is an iterative method based on the linear theory of inflatable plates and engineering beam theory. The wing is treated conceptually as a composite structure made from an edgeless inflatable plate and two semi-circular stiff edges. The second approach is by means of the stiffness matrix method. In this method, the wing is simulated physically by a system of spars and ribs that are orthogonal to each other. In each case, the natural frequencies and mode shapes of vibration are computed from these influence coefficients by means of a lumped-parameter method. All of the analytical results obtained in this study correlate very well with experimental works. Dissert. Abstr.

N71-22667 Iowa State Univ. of Science and Technology, Ames.
APPLICATION OF SELECTED FINITE DIFFERENCE TECHNIQUES TO THE SOLUTION OF CONICAL FLOW PROBLEMS
Paul Kutler (Ph.D. Thesis) 1969 213 p
Avail: Univ. Microfilms: HC $9.70/Microfilm $3.00 Order No. 70-7713

The inviscid flow fields about a pointed circular cone and a flat-top or conical wing-body configuration both at angle of attack are determined by applying first and second order differencing schemes to the gas-dynamic equations (in conservation-law form) and by utilizing the self-similar or conical nature of the flow field. A survey and analysis which includes an experimental and theoretical stability study of these finite difference schemes is performed. The purpose of the cone study is to develop a numerical method which will predict the flow field when the angle of attack is increased far enough such that embedded shock waves are formed on the lee side of the cone as a result of the large cross-flow velocities. Dissert. Abstr.

N71-22672*# Northrop Corp., Hawthorne, Calif. Aircraft Div.
FLOW FIELDS OVER SHARP EDGED DELTA WINGS WITH ATTACHED SHOCKS
S. A. Powers and E. R. Beeman, Jr. Washington NASA Apr. 1971 67 p refs
(Contract NAS1-7850)
(NASA-CR-1738) Avail: NTIS CSCL 20D

The problem of supersonic and hypersonic flow of an inviscid ideal gas over conical wings with sharp leading edges and attached shock waves has been treated using the three-dimensional method of characteristics. Solutions for both the expansion and compression side have been developed and provided as highly automated computer programs. These programs provide for wing cross sections of flat plate, modified wedge, or general conic shapes. Since the flow fields on upper and lower surfaces are independent the total wing shape can be a combination of any two of these three shapes. These solutions require from one to three minutes on a CDC 6600 computer and provide an accurate description of the flow field between the body and the external boundary (the shock wave on the compression side and the free stream on the expansion side). Results from these programs are compared with experimental and theoretical data. Author

N71-23091*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FLUTTER SUPPRESSION USING ACTIVE CONTROLS BASED ON THE CONCEPT OF AERODYNAMIC ENERGY
E. Nissim Washington Mar. 1971 115 p refs
(NASA-TN-D-6199; L-7525) Avail: NTIS CSCL 01A

The problem of flutter suppression is treated from an energy point of view, whereby the energy dissipated per cycle of oscillations is reduced to a quadratic form involving a diagonal matrix of energy eigenvalues which are of aerodynamic origin only. A simplified binary bending-torsion flutter of a wing strip is investigated by several systems: leading edge control surface, trailing edge control surface, and combined leading edge−trailing edge control surfaces. In each case the control surfaces are allowed to be driven by a linear sensor, a rotational sensor, and a combined linear rotational sensor system. The results show that the flutter of the wing strip can be suppressed, a single control law being used, over a wide range of reduced frequencies, irrespective of the mass of the system, its stiffness, center of gravity location, elastic axis, the mode of vibration, and the Mach number (in the subsonic range). Parameters affecting the implementation of the control law, such as power requirements, phase lags, and amplitude gains, are investigated. The extension of the results to three dimensional flow cases is discussed, and the use of the flutter suppressor as a gust alleviator is also considered. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N71-21874# Spess (R. Dixon) Associates, Palo Alto, Calif.
NORCALSTOL: A REPORT ON THE NORCALSTOL DEMONSTRATION, 13−15 MAY 1970
1970 80 p Prepared in cooperation with Chamber of Commerce, San Francisco
Avail: NTIS

Demonstration flights of several short takeoff aircraft were conducted at San Francisco, California. The purpose of the flights was to promote the use of such aircraft as commercial transportation system to improve access to the city. Aircraft which participated in the demonstration were: (1) Britten – Norman Islander, (2) Helio H-550A Stallion, (3) Helio H-295 Super Courier, (4) De Havilland Twin Otter, (5) Fairchild Hiller Heliporter, and (6) Cessna Super Skymaster. P.N.F.

N71-21922# Honeywell, Inc., Minneapolis, Minn. Systems and Research Div.

OPTIMAL FUEL SYSTEM ESTIMATION

Nelson R. Zagalsky 30 Oct. 1970 39 p refs

(Contract N00014-69-C-0101)

(AD-717640; Rept-12591-TR-1E1) Avail: NTIS CSCL 21/4

The application of Kalman (Linear Least Squares Recursive) filtering to the estimation of fuel quantity and fuel rate for fighter aircraft is discussed. Error analyses are presented for the resultant filter. The blending of quantity and rate information is shown to offer a tradeoff between required system accuracies and individual sensor accuracies. Author (GRA)

N71-21927# National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.

ENGINE SNOW INGESTION IN THE BELL 206A JET RANGER HELICOPTER

J. B. Stallabrass Jan. 1971 20 p

(NRC-11893; MET-513) Avail: NTIS

To investigate reported cases of engine flameout occurring during flight in snow, tests were made on a ground-running helicopter, using a device for generating artificial snow. The tests showed that operation in snow could result in engine flameout, largely as a result of accumulations of ice being formed in the engine inlet plenum chamber. It is concluded that flight in any condition of snow is unsafe with the existing engine inlet configuration of this helicopter. Author

N71-21976# Federal Aviation Administration, Washington, D.C.

SECOND MEETING OF THE SONIC BOOM PANEL. REPORT OF THE US DELEGATION

19 Nov. 1970 112 p Conf. held at Montreal, 12 – 21 Oct. 1970

(IGIA-17/4.8) Avail: NTIS

The second meeting of the ICAO Sonic Boom Panel convened at ICAO headquarters, Montreal, on October 12, 1970. On October 21, 1970, the panel concluded its meeting in Montreal by submitting to the Air Navigation Commission a report entitled, Report on the Sonic Boom Phenomenon, the Ranges of Sonic Boom Values Likely to be Produced by Planned SSTS and the Effects of Sonic Boom on Humans, Property, Animals and Terrain. This report had initially been developed at the Panel's First Meeting and has since been amended and expanded upon, both by correspondence between members and at an ad hoc meeting of panel members held in Paris during February 1970. Specific recommendations were made and it was considered that sufficient progress had been made by the panel within its initial terms of reference with reference to Stages 1 and 2 to allow transition to Stage 3 of the Council's Staged Plan of Action of Steps to be Taken to Facilitate Compliance with Resolution A16-4. Author

N71-21977# Federal Aviation Administration, Washington, D.C. Office of Management Systems.

AVIATION STATISTICS: AIRPORTS, AIR CARRIER FLEET, AIRCRAFT PRODUCTION, AND AIRMEN

Sep. 1970 23 p

Avail: NTIS

A summary of the statistics pertaining to various aspects of civil aviation is presented. Subjects discussed are: (1) number of joint-use landing facilities, (2) size of United States civil air fleet, (3) general aviation utilization, (4) airline operations, (5) civil aircraft production, and (6) trends in pilot training and licensing. P.N.F.

N71-21978# Federal Aviation Administration, Washington, D.C. Bureau of National Capital Airports.

ANALYSIS OF BOEING 727-200 OPERATIONS AT WASHINGTON NATIONAL AIRPORT

Feb. 1971 25 p

Avail: NTIS

During the period April through October 1970, the Bureau of National Capital Airports conducted an analytical study of the operations of the Boeing 727-200 aircraft at Washington National Airport. The 727-200 is identical (same basic power plant and wing/flap geometry) to the 727-100 except for an extra 20-foot fuselage section which provides additional seating capacity. The 727-100 has operated at Washington National since it was opened to jet aircraft in 1966. The study included close observation for impact on environment, air and surface traffic management, passenger processing, passenger boarding trends, and scheduled and total operation trends. The effect of the current nationwide decline in airline business, evident at all three area airports, was also taken into account. Analysis of the data collected during the study period indicates that the 727-200 had no adverse impact on conditions at Washington National or on the growth and utilization of Dulles International Airport. Author

N71-21980# Federal Aviation Administration, Washington, D.C. Office of Environmental Quality.

JET ENGINE NOISE DATA FROM SUBSONIC AIRCRAFT, MARCH – APRIL 1971

1971 42 p Presented at the Intern. Short Course on Aircraft Noise Theory and Appl., Knoxville, Tenn., 15 – 20 Mar. 1971 and at Aachen, 29 Mar. – 3 Apr. 1971

Avail: NTIS

The acoustic considerations of aircraft noise have led to the development of several basic descriptors of that noise. The first descriptor of an aircraft sound is its representation as a sound level spectrum. A sound level spectrum presents the intensity of the sound in decibels as a function of the frequency in hertz. Sound level spectra may be developed by the use of weighting functions to give perceived noisiness and then factored for discrete frequency and duration. The final descriptor for the description of noise in the vicinity of an airport is called the noise exposure forecast. The noise exposure forecast considers the daily operations in the airport environment. It uses the effective perceived noise level which is combined ultimately with the number of operations weighted for the type of aircraft, including the flight profile of each aircraft with additional weighting factors for the night and daytime operations. Author

N71-22069*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

FLIGHT INVESTIGATION OF A V/STOL TRANSPORT MODEL HAVING SIX WING-MOUNTED LIFT FANS

William A. Newsom, Jr. and Sue B. Grafton Washington Apr. 1971 29 p refs

(NASA-TN-D-6198; L-7560) Avail: NTIS CSCL 01C

The investigation consisted of free-flight model tests in hovering and forward flight through the transition speed range up to the speed where conversion would be made to wing-borne flight. Dynamic lateral-directional stability characteristics of the model were also calculated to explain the flight-test results. The model was flyable without artificial stabilization but, in general, angular rate damping was required to make the flight characteristics satisfactory. Author

N71-22136# Naval Postgraduate School, Monterey, Calif.
INTERFACE OF MATERIALS AND STRUCTURES ON AIRFRAMES. PART 2: OUTLINE OF DECISION PROCESS IN STRUCTURAL DESIGN
Ulrich Haupt Dec. 1970 57 p refs
(AD-717576; NPS-57HP0121A-Pt-2) Avail: NTIS CSCL 1/3

The decision process in structural design becomes increasingly important with the introduction of new materials. Starting from a consideration of present problems in structural design, an outline is developed for the decision process with particular emphasis on interaction between materials, structures, and design. This outline, however, still lacks the details which are required for an analytical model of the decision process. These missing details are identified and a practical approach toward their solution is shown.
Author (GRA)

N71-22147# National Aerospace Lab., Tokyo (Japan).
MODEL TEST ON DEFLECTED JET PIPES OF THE NAL FLYING TEST BED
Yoshikazu Tanabe Oct. 1970 10 p refs In JAPANESE; ENGLISH summary
(NAL-TR-209) Avail: NTIS

Problems associated with VTOL operations of a lift-type aircraft are evaluated in order to improve flight safety. Deflecting jet pipes with different deflecting angles are tested to obtain the relationships between the real deflection angle and the geometrical deflection angle, the jet pipe thrust coefficient, etc. for suppression of pitching moment caused by one engine failure. It is concluded that the real deflection angle is nearly 90% of the geometrical deflection angle and that the thrust coefficient of the deflecting jet pipes is not less than 86% regardless of the geometrical deflection angle.
Author

N71-22174# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.
THE FEASIBILITY OF UTILIZING COLOR CATHODE RAY TUBES FOR AIRCRAFT CREW STATION DISPLAYS Technical Report, Feb.–May 1970
Ronald S. Vokits Nov. 1970 47 p refs
(AD-717655; ASD-TR-70-33) Avail: NTIS CSCL 1/4

The report compiles the characteristics of various state-of-the-art color cathode ray tubes (CRTs). The structures, theory of operation, and technical advantages and disadvantages of the various color CRTs for use in aircraft display instruments are evaluated. The results of the study were that presently available types of color CRTs are not suitable for cockpit displays and the Penetron and other non-patterned screens could be used in low ambient light areas.
Author (GRA)

N71-22186# Deutsche Gesellschaft fuer Luft- und Raumfahrt, Cologne (West Germany).
FUTURE COMMERCIAL FLIGHT TECHNIQUES [VERKEHRSFLUGTECHNIK DER ZUKUNFT]
Nov. 1970 239 p refs In GERMAN Proc. of the DGLR Symp., Hamburg, 29 Jan. 1970
(DLR-MITT-70-15) Avail: NTIS; ZLDI Munich: 50 DM

CONTENTS:

1. THE VTOL JET FOR A FUTURE V/STOL TRANSPORT SYSTEM B.Huinink (Dornier-Werke, Friedrichshafen) and K. B. Brink (Dornier-Werke, Friedrichshafen, West Ger.) p 7–32 refs (See N71-22187 11-02)

2. MARKET SITUATION FOR V/STOL AIRCRAFT H. Hoeppner (Ver. Flugtech. Werke-Fokker, Munich, West Ger.) p 33–52 (See N71-22188 11-02)

3. AIR SPACE CONGESTION AND THE COMPOUND HELICOPTER S. I. Sikorsky (United Aircraft Intern.) p 53–66 (See N71-22189 11-02)

4. COMMERCIAL INTERPRETATION OF VTOL AIR LINERS H.-G. Klug (Hamburger Flugzeugbau) p 67–92 (See N71-22190 11-02)

5. PROPELLER-DRIVEN VTOL AIRCRAFT U. Dornseifer (Messerschmitt-Boelkow-Blohm, Munich) p 93–104 (See N71-22191 11-02)

6. APPLICATION ANALYSIS OF VTOL AIRCRAFT FOR FUTURE INTEGRATED INTERCITY TRAFFIC SYSTEM H.-R. Buschhorn (Ver. Flugtech. Werke-Fokker, Bremen) p 105–120 (See N71-22192 11-02)

7. VARIABLES INFLUENCING THE DIRECT OPERATIONAL COSTS OF A V/STOL PASSENGER AIRCRAFT K.-A. Wendt (Ver. Flugtech. Werke-Fokker, Munich) p 121–132 (See N71-22193 11-02)

8. LIFT FANS AND A FLEXIBLE SOLUTION FOR THE DEVELOPMENT OF VTOL PASSENGER AIRCRAFT A. Hartmann (Motoren-und Turbinen-Union) p 153–170 refs (See N71-22194 11-02)

9. INLET FLOW AND OUTLET JET INFLUENCE ON THE FLOW AROUND THE WINGS OF TWO LIFT FAN CONFIGURATIONS H. Neppert (Hamburger Flugzeugbau) p 170–218 refs (See N71-22195 11-02)

10. CONSIDERATIONS REGARDING THE DESIGN OF THE COCKPIT FOR A V/STOL AIRCRAFT J. Lindemann (Hamburger Flugzeugbau) p 219–228 (See N71-22196 11-02)

11. AIR TRAFFIC SECURITY, TODAY AND TOMORROW H. Herb (DFVLR, Brunswick) p 229–237 refs (See N71-22197 11-02)

N71-22187# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
THE VTOL JET FOR A FUTURE V/STOL TRANSPORT SYSTEM [DAS SENKRECHTSTARTENDE STRAHLFLUGZEUG IM RAHMEN EINES ZUKUENFTIGEN VSTOL-TRANSPORTSYSTEMS]
B. Huinink and K. B. Brink *In* DGLR Future Com. Flight Tech. Nov. 1970 p 7–32 refs In GERMAN (See N71-22186 11-02)
Avail: NTIS; ZLDI Munich: 50 DM

In view of the future demand in civil VTOL aircraft the advantages offered by the development of the DO-31 aircraft provide a basis for further development. An analysis of the aerodynamic characteristics, the aircraft safety, and operating costs leads to the conclusion that the German aerospace industry has high chances in this field.
ESRO

N71-22188# Vereinigte Flugtechnische Werke - Fokker G.m.b.H., Munich (West Germany).
MARKET SITUATION FOR V/STOL AIRCRAFT [MARKTSITUATION FUER V/STOL-FLUGZEUGE]
H. Hoeppner *In* DLGR Future Com. Flight Tech. Nov. 1970 p 33–52 In GERMAN (See N71-22186 11-02)
Avail: NTIS; ZLDI Munich: 50 DM

The market situation for V/STOL aircraft is assessed for both the military and civil aviation fields. The design and testing of prototypes, taking into account the special operational requirements is discussed and a specific design is proposed; a tilt wing aircraft with propeller drive in a tandem configuration.
ESRO

N71-22189# United Aircraft International Inc., Cologne (West Germany).
AIR SPACE CONGESTION AND THE COMPOUND HELICOPTER [DIE LUFTRAUM-UEBERFUELLUNG UND DER VERBUND-HUBSCHRAUBER]
S. I. Sikorsky *In* DLGR Future Com. Flight Tech. Nov. 1970 p 53–66 In GERMAN (See N71-22186 11-02)
Avail: NTIS; ZLDI Munich: 50 DM

As the majority of civil air transport is over short haul distances, and in view of air traffic control problems, a VTOL

solution to these problems is proposed. In particular, a compound and a normal helicopter design are described meeting the requirements derived from the above conditions. The use of advanced composite materials and retractable rotors is briefly discussed. ESRO

N71-22190# Hamburger Flugzeugbau G.m.b.H. (West Germany).
COMMERCIAL INTERPRETATION OF VTOL AIR LINERS [MARKTGERECHTE AUSLEGUNG VON VTOL-VERKEHRSFLUGZEUGEN]
H.-G. Klug *In* DGLR Future Com. Flight Tech. Nov. 1970 p 87–92 In GERMAN (See N71-22186 11-02)
Avail: NTIS; ZLDI Munich: 50DM

The reliability and operational requirements of short haul VTOL aircraft are discussed. A particular design is presented, featuring lift- and lift/cruise fans, using a conventional jet engine as a gas generator. The advantages of this design are outlined, in particular low noise generation and a spacious compartment. ESRO

N71-22191# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany)
PROPELLER-DRIVEN VTOL AIRCRAFT [PROPELLERGETRAGENE VTOL-FLUGZEUGE]
U. Dorneifer *In* DGLR Future Com. Flight Tech. Nov. 1970 p 93–104 In GERMAN (See N71-22186 11-02)
Avail: NTIS; ZLDI Munich: 50 DM

The advantages of propeller-driven tilt-wing aircraft for intercity transport are outlined. The advantages are in particular a lower noise generation as compared to both conventional and V/STOL jet engine powered aircraft, and the excellent STOL properties. ESRO

N71-22192# Vereinigte Flugtechnische Werke - Fokker G.m.b.H., Bremen (West Germany).
APPLICATION ANALYSIS OF VTOL AIRCRAFT FOR FUTURE INTEGRATED INTERCITY TRAFFIC SYSTEM [EINSATZANALYTISCHE UNTERSUCHUNGEN EINES ZUKUENFTIGEN INTERCITY-VERKEHRS-VERBUND-SYSTEMS MIT VTOL-FLUGZEUGEN]
H.-R. Buschhorn *In* DGLR Future Com. Flight Tech. Nov. 1970 p 105–120 In GERMAN (See N71-22186 11-02)
Avail: NTIS; ZLDI Munich: 50 DM

The operational problems of future integrated intercity VTOL traffic are discussed. A model is developed taking into account conventional ground transfer traffic to derive the optimum conditions for integrating different means of transport to minimize travel time. ESRO

N71-22193# Vereinigte Flugtechnische Werke - Fokker G.m.b.H., Munich (West Germany).
VARIABLES INFLUENCING THE DIRECT OPERATIONAL COSTS OF A V/STOL PASSENGER AIRCRAFT [EINFLUSSGROESSEN AUF DIE DIREKTEN BETRIEBSKOSTEN EINES V/STOL-PASSAGIERFLUGZEUGES]
K.-A. Wendt *In* DGLR Future Com. Flight Tech. Nov. 1970 p 121–132 In GERMAN (See N71-22186 11-02)
Avail: NTIS; ZLDI Munich: 50 DM

The aircraft under consideration is a tilt wing, propeller driven tandem aircraft with a flight range of 800 km. The different sources of operational costs are described and the influence of changes in the parameters are discussed. Finally, the tradeoff between increased cost versus overall travel time is mentioned. ESRO

N71-22194# Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany).
LIFT FANS AND A FLEXIBLE SOLUTION FOR THE DEVELOPMENT OF VTOL PASSENGER AIRCRAFT [GEBLAESEANTRIEBE UND EINE IN JEDER WEISE FLEXIBLE LOESUNG FUER DIE ENTWICKLUNG VON VTOL-VERKEHRSFLUGZEUGEN]
A. Hartmann *In* DGLR Future Com. Flight Tech. Nov. 1970 p 153–170 refs In GERMAN (See N71-22186 11-02)
Avail: NTIS; ZLDI Munich: 50 DM

The various design alternatives in VTOL aircraft thrust generation are compared, and a design with separate gas generator and thrust generator is discussed. The requirements imposed on the connecting tube, the gas generator, the fans, and their combination into a propulsion aggregate. Finally, the integration of the propulsion system into the aircraft body is discussed. ESRO

N71-22195# Hamburger Flugzeugbau G.m.b.H. (West Germany).
INLET FLOW AND OUTLET JET INFLUENCE ON THE FLOW AROUND THE WINGS OF TWO LIFT FAN CONFIGURATIONS [ZULAUF- UND STRAHLEINFLUESSE ZWEIER HUBGEBLAESEKONFIGURATIONEN AUF DIE FLUEGELSTROEMUNG]
H. Neppert *In* DGLR Future Com. Flight Tech. Nov. 1970 p 170–218 refs In GERMAN (See N71-22186 11-02)
Avail: NTIS; ZLDI Munich: 50 DM

Two configurations of lift fans were investigated as to the influence of the inlet and outlet flow on the aerodynamic forces and moments. A half-model was placed into a wind tunnel to measure the pressure distribution over several airfoil sections. The two configurations under test were compared concerning longitudinal stability, cruising flight drag, and tilting moments. ESRO

N71-22196# Hamburger Flugzeugbau G.m.b.H. (West Germany).
CONSIDERATIONS REGARDING THE DESIGN OF THE COCKPIT FOR A V/STOL AIRCRAFT [UEBERLEGUNGEN ZUR GESTALTUNG DES COCKPITS EINES V/STOL-TRANSPORTERS]
J. Lindemann *In* DGLR Future Com. Flight Tech. Nov. 1970 p 219–228 In GERMAN (See N71-22186 11-02)
Avail: NTIS; ZLDI Munich: 50 DM

A mockup of a V/STOL aircraft cockpit is presented. The requirements imposed on such a cockpit are outlined, and the resulting design is described. ESRO

N71-22197# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst fuer Flugmechanik.
AIR TRAFFIC SECURITY, TODAY AND TOMORROW [DIE SICHERHEIT IM LUFTVERKEHR, HEUTE UND MORGEN]
H. Herb *In* DGLR Future Com. Flight Tech. Nov. 1970 p 229–237 refs In GERMAN (See N71-22186 11-02)
Avail: NTIS; ZLDI Munich: 50 DM

The development of accident figures in air traffic is discussed; the factors influencing them, human errors, technical failures, clear air turbulence, and cosmic radiation are described. ESRO

N71-22381# National Council for Civil Aviation, Tel Aviv (Israel).
CIVIL AVIATION IN THE 1970's
1969 303 p Presented at the Ann. Symp. on Current Probl. in Civil Aviation, Tel Aviv, Israel, 8–9 Oct. 1969
Avail: NTIS HC $6.00/MF $0.95

CONTENTS:

1. ADDRESS BY THE MINISTER OF TRANSPORT M. Carmel (Israel Ministry of Transport and Communications, Tel-Aviv) 10 p (See N71-22382 11-02)

2. TECHNOLOGICAL TRENDS AND FORECASTS FOR THE 1970's J. D. Blatt (FAA, Washington, D.C.) 13 p (See

N71-22383 11-02)

3. ECONOMIC ASPECTS OF THE EXPECTED DEVELOPMENT IN AIR TRANSPORT IN THE NEXT DECADE J. Mercier (Inst. of Transport Aviation, Paris, France) 13 p (See N71-22384 11-02)

4. PROBLEMS OF CIVIL AVIATION IN THE NEXT DECADE M. Ben-Ari (EL AL Israel Airlines, Ltd.) 28 p (See N71-22385 11-02)

5. THE B-747 AND DEVELOPMENT OF THE SST G. Snyder (Boeing Co., Seattle, Wash.) 53 p (See N71-22386 11-02)

6. CONTINUED PROGRESS ON CONCORDE M. G. Wilde (British Aircraft Corp., Filton, England) 29 p (See N71-22587 11-02)

7. EL-AL'S PLANNING FOR THE INTEGRATION OF THE B-747 S. Eshel (EL AL Israel Airlines, Ltd.) 8 p (See N71-22388 11-02)

8. THE AIRPLANE AND THE AIRPORT L. Achitoff (Port of New York Authority, N.Y.) 28 p (See N71-22389 11-02)

9. ACCOMMODATING PASSENGERS AND CARGO D. C. Ramage (British Airports Authority, London England) 27 p (See N71-22590 11-02)

10. DEVELOPMENT OF CIVIL AVIATION IN ISRAEL IN THE 1970's R. Harel (Israel Ministry of Transport and Communications, Tel-Aviv) 21 p (See N71-22391 11-02)

11. TRENDS IN SPACE ACTIVITY D. Abir (Technion-Israel Inst. of Tech., Haifa) 4 p (See N71-22392 11-02)

12. FROM APOLLO 11 TO THE SPACE STATIONS OF THE FUTURE H. Cohen (NASA, Washington, D.C.) 29 p (See N71-22393 11-30)

13. CONTRIBUTIONS OF THE SPACE PROGRAMME TO AVIATION H. Cohen (NASA, Washington, D.C.) 25 p (See N71-22394 11-30)

N71-22382# Israel Ministry of Transport and Communications, Tel-Aviv.

ADDRESS BY THE MINISTER OF TRANSPORT

M. Carmel *In* Natl. Council for Civil Aviation Civil Aviation in the 1970's 1969 (See N71-22381 11-02) 10 p

Avail: NTIS HC$6.00/MF$0.95

Planning and developments in civil aviation are outlined. Considered are future technological and economic trends, the operation of new transport aircraft, the production of transport aircraft in Israel, the planning of modern airports and other related problems. G.G.

N71-22383# Federal Aviation Administration, Washington, D.C.

TECHNOLOGICAL TRENDS AND FORECASTS FOR THE 1970's

Joseph D. Blatt *In* Natl. Council for Civil Aviation Civil Aviation in the 1970's 1969 13 p (See N71-22381 11-02)

Avail: NTIS HC$6.00/MF$0.95

Traffic generating potentials of air transportation and the problems that must be solved to insure increasing systems capacity are discussed by analyzing market forecasts of unconstrained growth for the U.S. air traffic. Large scale changes to employ 747 aircraft and SST aircraft demand sophisticated technology and high speeds. Improved air traffic control and navigation systems as well as passenger handling facilities are proposed that rely on automatic simulators to provide guidance for traffic optimization. Volumetric navigation, aided by scanning satellites, atomic clocks, ground to air and air to ground synchronization techniques, precise time and precise frequency standards provide the required flexibility in the use of air space and meet specific operational needs of air traffic developments. G.G.

N71-22384# Institute of Transport Aviation, Paris (France).

ECONOMIC ASPECTS OF THE EXPECTED DEVELOPMENT IN AIR TRANSPORT IN THE NEXT DECADE

Jean Mercier *In* Natl. Council for Civil Aviation Civil Aviation in the 1970's 1969 13 p (See N71-22381 11-02)

Avail: NTIS HC$6.00/MF$0.95

The main positive and negative economic aspects directly concerning commercial aviation development in the next decade are discussed: (1) financing appears to be one of the most complex problems to solve; (2) profitability, owing to heavier charges and labor costs, will perhaps not be able to maintain a good level, (3) vertical integration for extensions of transport activities at the level of tourism and customer facilities; (4) the uncertainty concerning the size of firms which will have to meet these commitments; (5) the consequences at the economic and organizational level of maintaining or increasing the flexibility in traffic; (6) adaptation to the changing market which is developing rapidly; and (7) the increasing importance of the operations preceding and following the actual transport process with regard to surface transport media. Author

N71-22385# EL AL Israel Airlines, Ltd., Tel Aviv.

PROBLEMS OF CIVIL AVIATION IN THE NEXT DECADE

M. Ben-Ari *In* Natl. Council for Civil Aviation Civil Aviation in the 1970's 1969 28 p (See N71-22381 11-02)

Avail: NTIS HC$6.00/MF$0.95

The main problems are listed that will become critical with the introduction of giant and supersonic aircraft into international civilian air transport: (1) financing; (2) economics of airline operations; (3) marketing and development of traffic; (4) security problems; (5) overland transportation and ground services; and (6) charter flights. Considerable emphasis is placed on expected air traffic developments in Israel. G.G.

N71-22386# Boeing Co., Seattle, Wash.

THE B-747 AND DEVELOPMENT OF THE SST

G. Snyder *In* Natl. Council for Civil Aviation Civil Aviation in the 1970's 1969 53 p (See N71-22381 11-02)

Avail: NTIS HC$6.00/MF$0.95

The 747 and SST airplanes are designed to meet the challenges of the expanding air travel market of the 1970's. Both airplanes are designed to operate from existing airports and to minimize noise at the airports. The SST will operate so as to preclude sonic boom problems en route by operating international routes at supersonic speeds, and domestic routes at transonic speeds. The 747 status reflects the confidence of the initial design. Development flight testing has been essentially completed, and the airplane characteristics have been proven to permit initiation of FAA certification demonstration. Analysis of flight data indicates the airplane performance is equal or better than predicted. The only remaining developmental area of significance relates to engine performance. Author

N71-22387# British Aircraft Corp., Filton (England).

CONTINUED PROGRESS ON CONCORDE

M. G. Wilde *In* Natl. Council for Civil Aviation Civil Aviation in the 1970's 1969 29 p (See N71-22381 11-02)

Avail: NTIS HC$6.00/MF$0.95

Certification flight development for the Concorde is outlined; reported flight testing on two prototypes included 1500 hours of endurance flying and direct application on airline routes. Improvements during design progress are described and operating cost trends are analyzed. Revenue yields, costs and load factors for the Concorde and the remaining subsonic traffic clearly project a single class operation for the supersonic transport as the best economic choice. G.G.

N71-22388# EL AL Israel Airlines, Ltd., Tel Aviv.

EL-AL'S PLANNING FOR THE INTEGRATION OF THE B-747

S. Eshel *In* Natl. Council for Civil Aviation Civil Aviation in the

1970's 1969 8 p (See N71-22381 11-02)
Avail: NTIS HC /6.00/MF $0.95

The airplane is only one component in a complex system consisting of man-power, equipment, structure, know-how, methods and procedures, all of which are required to enable the aircraft to perform its function: flying. Described are some planning activities and preparations for the integration of the 747 aircraft into Israel airline operations. Author

N71-22389# Port of New York Authority, N.Y. Aviation Technical Services Div.
THE AIRPLANE AND THE AIRPORT
Louis Achitoff *In* Natl. Council for Civil Aviation Civil Aviation in the 1970's 1969 28 p (See N71-22381 11-02)
Avail: NTIS HC $6.00/MF $0.95

The parameters that require evaluation in the planning of an international airport intended to accommodate new generation, high capacity aircraft are discussed. The infrastructure of airport-airplane requirements includes runway/taxiway dimensional trends, taxiway-to-taxiway separation, holding space, noise reduction, recovery of disabled aircraft, and fire and rescue operations. Emphasis is placed on the necessity of including the airport operations area as part in a public transportation system. G.G.

N71-22390# British Airports Authority, London (England).
ACCOMMODATING PASSENGERS AND CARGO
D. C. Ramage *In* Natl. Council for Civil Aviation Civil Aviation in the 1970's 1969 27 p (See N71-22381 11-02)
Avail: NTIS HC $6.00/MF $0.95

Airside and landside parts of the overall planning for supporting structures in expanding civil aviation traffic are discussed. The system is evaluated from the point where the payload leaves the airport and joins the external ground transport system to the centers of population and industry. Considered are passenger and cargo travel between the aircraft and the private car, public service vehicle, truck, railway train, etc., with application to Heathrow airport and its handling of larger and faster aircraft. The aircraft is considered the starting point of the systems approach followed by airline/airport administration and cooperation with government levels as well as a scheduling for concept integration. G.G.

N71-22391# Israel Ministry of Transport and Communications, Tel-Aviv.
DEVELOPMENT OF CIVIL AVIATION IN ISRAEL IN THE 1970's
R. Harel *In* Natl. Council for Civil Aviation Civil Aviation in the 1970's 1969 21 p (See N71-22381 11-02)
Avail: NTIS HC $6.00/MF $0.95

Four main points are stressed in the development of civil aviation in Israel: (1) aviation is regarded as a leading branch of the national economy; (2) cargo, in terms of extent, may take precedence over passengers; (3) measures to improve the supporting infrastructure in handling expected growth in passenger and cargo traffics; and (4) emphasis on systems planning in reaching important decisions. A master-plan presently incorporates electronic low-approach aids and communications as well as the introduction of terminal radar equipment to meet the requirements for increased air traffic operations during the 1970's. G.G.

N71-22392# Technion-Israel Inst. of Tech., Haifa.
TRENDS IN SPACE ACTIVITY
D. Abir *In* Natl. Council for Civil Aviation Civil Aviation in the 1970's 1969 4 p (See N71-22381 11-02)
Avail: NTIS HC $6.00/MF $0.95

The following topics are discussed: (1) justification of the Apollo program; (2) achievements in space flight and research; (3) unmanned satellites for useful applications; (4) manned satellites and spacecraft; (5) manned versus unmanned spacecraft missions; (6) budgets for space activity; and (7) space transportation trends. Author

N71-22431# Aeronautical Research Inst. of Sweden, Stockholm.
STUDY OF INSPECTION INTERVALS FOR FAIL SAFE STRUCTURES
Sigge Eggwertz and Goeran Lindsjoe Jan. 1970 59 p refs
(FFA-120) Avail: NTIS

Based on a method of evaluating the reliability of failsafe structures, a theoretical investigation, applicable to an aircraft wing, has been made of the influence of the length of inspection intervals which are both constant and varying. An optimum study shows that the least number of regular inspections during the service life is obtained by making especially the first interval considerably longer than the following ones. This result presupposes that all fatigue cracks occurring may be statistically anticipated. Unexpected cracks are likely to appear, however, during an initial "debugging period", and have to be considered when determining the first inspection intervals. Unscheduled inspections, randomly distributed in time, decrease the risk of total failure but are shown to be much less effective than regular inspections. Author

N71-22458# National Bureau of Standards, Washington, D.C. Photometry Div.
DEVELOPMENT, TESTING, AND EVALUATION OF VISUAL LANDING AIDS Consolidated Progress Report, 1 Jul.–30 Sep. 1970
12 Jan. 1971 14 p
(NBS-10508) Avail: NTIS

Evaluations of several types of aircraft approach and landing systems are presented. Subjects discussed are: (1) aviation ground lighting, (2) development, testing, and evaluation of visual landing aids, (3) operational tests of Dual-Baseline Transmissometer system, (4) photometric measurements of a deck-landing projector sight, and (5) DCA type lamp for Fresnel Optical Landing System. Author

N71-22538*# Goodyear Aerospace Corp., Akron, Ohio.
DESIGN, FABRICATION, AND STATIC TESTING OF ATTACHED INFLATABLE DECELERATOR (AID) MODELS
G. L. Faurote 1 Mar. 1971 95 p refs
(Contract NAS1-9726)
(NASA-CR-111831; GER-14940) Avail: NTIS CSCL 01C

Three attached inflatable decelerator models were designed and fabricated for supersonic wind tunnel evaluation. The models incorporate four quick-release aeroshell inlets to accomplish deployment and four canopy inlets to effect final canopy pressurization. It was demonstrated by a rapid inflation test that the model's inlet release system and packaging and deployment system are workable. E.M.C.

N71-22620*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SUMMARY OF CENTER-OF-GRAVITY ACCELERATIONS EXPERIENCED BY COMMERCIAL TRANSPORT AIRPLANES IN LANDING IMPACT AND GROUND OPERATIONS
Paul A. Hunter Washington Apr. 1971 66 p refs
(NASA-TN-D-6124; L-7483) Avail: NTIS CSCL 01C

Data are presented on incremental normal accelerations due to landing impacts and to ground operations associated with taxi, takeoff, and landing. NASA VGH recorders, installed in a total of 38 turbine-powered airplanes of both foreign and domestic airlines, were used to obtain the data. Limited data on longitudinal deceleration during landing are also presented. Author

N71-23007* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
METEOROLOGICAL BALLOON Patent
James R. Scoggins, inventor (to NASA) Issued 12 Sep. 1967 (Filed 7 Jan. 1965) 7 p Cl. 73-189
(NASA-Case-XMF-04163; US-Patent-3,340,732; US-Patent-Appl-SN-424156) Avail: US Patent Office CSCL 01C

A meteorological balloon is described having high aerodynamic stability. The balloon contains uniform conical surface protuberances to provide roughness and stable boundary layer separation. E.C.

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N71-21898 Colorado Univ., Boulder.
THEORY OF THE SOLID ROTOR INDUCTION MACHINE
James Clayton Wilson (Ph.D. Thesis) 1969 429 p
Avail: Univ. Microfilms: HC $19.35/Microfilm $5.50 Order No. 70-5907

Extremely high-speed polyphase induction motors for aerospace applications must be designed with solid rotors because windings cannot withstand rotation stresses. The high performance expected calls for an analysis that takes into account the nonlinearity of the rotor iron and the finite length of the motor, complexities not considered in an acceptable form by former researchers. This type of analysis is applied to predetermine the characteristic of a 5 h.p., 145 volt, 3200 Hz, three-phase, wye-connected solid rotor induction motor. After a historical review, a developed mathematical model is described. The partial differential equation and the boundary conditions, considering fully the motion of the rotor, are developed from Maxwell's equations. The relationship of the terminal voltage and of a current sheet representing the stator slot currents is developed. The torque of the induction motor as a function of the slip is developed from Poynting's theorem. Dissert. Abstr.

N71-21991# British Aircraft Corp., Filton (England). Guided Weapons Technical Publications Dept.
A STUDY OF ADVANCED SOLAR ARRAY DESIGN Quarterly Report, 1 Nov. 1969 – 31 Jan. 1970
K. K. Reinhartz comp. and D. W. Mann comp. Paris ESRO Mar. 1970 70 p Sponsored by ESRO
(Contract ESTEC-623/68sl)
(ESRO-CR-17; QPR-4) Avail: NTIS

Coverage is given to demonstration of the D1 model of a rolled satellite solar array which incorporates live solar cell patches and which has satisfactorily undergone a part of its system qualification program. Welded joints between the cells and silver mesh were evaluated and the model subjected to thermal patch, thermal vacuum, vibration, acceleration, and other tests. Details of apparatus used in the tests are given. Author (ESRO)

N71-22279# Bell and Howell Research Center, Pasadena, Calif. Electronic Materials Div.
ANALYTICAL TECHNIQUES FOR THE DETERMINATION OF TRACE IMPURITIES IN 2-6 COMPOUNDS Final Technical Report, 1 Jun. 1969 – 31 May 1970
Arthur J. Socha, Eleanor M. Masumoto, and Robert K. Willardson Sep. 1970 147 p refs
(Contract F33615-68-C-1635)
(AD-717706; ARL-70-0170) Avail: NTIS CSCL 7/4

The operating and failure mechanisms of Cu2S:CdS thin film solar cells were examined. The short circuit current of pilot production cells was found to be sensitive to the uniformity of Zn plating and to the texture of the metallized plastic substrate. The reason for this sensitivity is unknown, but it is probably related to the influence that the Zn plating has on the CdS film structure and on the ohmicity of the base contact. Extensive literature and experimental studies on the various forms of cuprous sulfide were carried out. An important experimental result was the discovery of the phase changes that result when the initially formed chalcocite is exposed to air, even at room temperature. Djurleite appears to be the phase present in normal cells. The phase transition that occurs in the vicinity of 100C is reversible and apparently does not damage the cell. The surface of the cuprous sulfide must be oxidized in order to obtain a strong photovoltaic effect. A reduced surface leads to excessive surface recombination probably aided by a surface junction having a polarity opposite to that of the Cu2S:CdS heterojunction. The threshold voltage for electrolytic deposition of Cu from Cu2S is the potential of a Cu-vacancy concentration cell in which the activity of Cu at the cathode is unity. Author (GRA)

N71-22364*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DYNAMIC ELECTRICAL CHARACTERISTICS OF A 400-HERTZ BRAYTON CYCLE TURBOALTERNATOR AND CONTROLS
Martin E. Valgora Washington Mar. 1971 50 p refs
(NASA-TN-D-6185; E-5956) Avail: NTIS CSCL 10C

The major electrical components of a 5- to 15-kWe, 400-Hz Brayton space electric power system were operated together and found to satisfy the requirements of space application. The electrical system consists of a gas-bearing turboalternator, a voltage regulator-exciter, and a parasitic-loading speed controller. Experimental results of electrical transient tests are presented. System characteristics were determined and compared with previously obtained component test results. The following specific areas were investigated: parasitic-loading speed controller control characteristics, full-load step transients, voltage and frequency excursions and recovery times, effects of speed controller gain variation, power transients, startup and shutdown characteristics, and short-circuit performance. Author

N71-22480# Unidynamics/Phoenix, Ariz.
THE DEVELOPMENT OF PELLETIZED HEAT SOURCES FOR THERMAL BATTERIES
C. T. Rittenhouse Nov. 1970 95 p Sponsored by AEC Prepared for Sandia Corp., Albuquerque, N.Mex.
(SC-CR-70-6137) Avail: NTIS

The development of pelletized heat sources for thermal batteries is investigated. Emphasis was given to improving existing NX-1000 iron/potassium perchlorate heat powder, test equipment, and techniques. A summary is given for major findings in: (1) calorimetry, (2) ignition sensitivity testing, (3) potassium perchlorate investigations, (4) heat powder blending, (5) pellet density versus ignition sensitivity, (6) pellet density versus pellet breaking strength, (7) pellet strength, and (8) NX-100 iron powder evaluation. A summary, recommendations, and conclusions are given for each major area. Author

N71-22561*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Guidance and Control Div.
DESIGN AND DEVELOPMENT OF A 66-W/kg 23-m SQUARE ROLL UP SOLAR ARRAY
W. A. Hasbach *In its* JPL Quarterly Tech. Rev., Vol. 1, No. 1 Apr. 1971 p 68–77 ref (See N71-22551 11-30)
Copyright. Avail: NTIS HC$6.00/MF$0.95 CSCL 10A

Future space missions require greater power output, lighter weight, and decreased stowed volume for solar arrays. A program

was initiated to develop the technology for a roll-up solar array by preparing a detailed design, performing the associated analyses, fabricating an engineering development model, and subjecting the engineering model to a comprehensive test program consisting of both environmental and developmental tests. The design and testing of the 66-W/kg (30-W/lb), 23-sq m (250 sq ft) roll-up solar array developed is described. Author

N71-22570*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

MOTOR START OF A 2- TO 10-KILOWATT BRAYTON ROTATING UNIT OPERATING ON GAS BEARINGS IN A CLOSED LOOP

Robert C. Evans, Robert Y. Wong, and Charles H. Winzig Washington Apr. 1971 15 p refs

(NASA-TM-X-2266; E-6069) Avail: NTIS CSCL 10B

The Brayton rotating unit (BRU) was motor started in a closed-loop test facility using the alternator as a motor. The results obtained are presented in terms of minimum required turbine inlet temperature and speed for self-sustaining operation and acceleration time required to reach the design operating speed of 36,000 rpm. Author

N71-22974* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

SEALING DEVICE FOR AN ELECTROCHEMICAL CELL Patent

Thomas J. Hennigan, inventor (to NASA) Issued 7 May 1968 (Filed 8 Oct. 1965) 3 p Cl. 136-132

(NASA-Case-XGS-02630; US-Patent-3,382,107; US-Patent-Appl-SN-494287) Avail: US Patent Office CSCL 10C

A sealing device for a standard electrochemical cell is described which enables use of the cell in low pressure environments. The cell, except for its top, is enclosed by a housing with one terminal and an end wall of the cell transfixed in a layer of hardened epoxy resin. A means is provided for permitting external electrical contact with the terminal. Official Gazette of the U.S. Patent Office

N71-23006* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

BONDED ELASTOMERIC SEAL FOR ELECTROCHEMICAL CELLS Patent

Joseph M. Sherfey, inventor (to NASA) Issued 5 Sep. 1967 (Filed 15 Jan. 1965) 4 p Cl. 136-133

(NASA-Case-XGS-02631; US-Patent-3,340,099; US-Patent-Appl-SN-425972) Avail: US Patent Office CSCL 10C

The leak-resistant elastomeric seal is applicable to secondary cells containing strongly alkaline electrolytes. A cell lid configuration is used in which a portion of a metallic cell lid is folded back and away from an aperture within the cell lid to provide a longer metallic path between weld points on the outer periphery of the cell lid and an elastomeric sealant which is positioned within the aperture. E.C.

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N71-21851# Federal Aviation Administration, Oklahoma City, Okla. Office of Aviation Medicine.

TOLERANCES TO THERMAL EXTREMES IN AEROSPACE ACTIVITIES

P. F. Iampietro Dec. 1970 13 p refs

(FAA-AM-70-22) Avail: NTIS

Tolerance for all hot environments cannot be defined by a single criterion. At least three types of tolerance are discussed which might occur in aerospace activities. The tolerance categories have been designated (1) pain limited, (2) heat storage limited and (3) systems limited. Pain limited exposures are of short duration and require very high temperatures. Heat storage limited exposures may last from minutes to hours and require high temperatures and low humidities. Systems limited exposures are of intermediate duration and require moderately high temperatures and high humidities. Author

N71-21852# Federal Aviation Administration, Oklahoma City, Okla. Office of Aviation Medicine.

COMPARISON OF STATUS VARIABLES AMONG ACCIDENT AND NONACCIDENT AIRMEN FROM THE ACTIVE AIRMAN POPULATION

Michael T. Lategola, Vincent Fiorica, Charles F. Booze, Jr., and Earl D. Folk Dec. 1970 19 p refs

(FAA-AM-70-18) Avail: NTIS

The distributions of age, weight, height, body weight/body surface area and ponderal index for the accident versus nonaccident segments of the active airman population were compared for years 1966–1967. The differences in the distributions of these five status variables in the accident versus non-accident population segments were statistically significant in all instances. The accident rate increased with age and was highest for ages of 60 or greater. The accident rate also increased with the variables related to increasing body weight. The interrelationship between age and body weight represents the most obvious focus for future research efforts. Various paired combinations of age with each of the other four variables are potentially capable of narrowing the focus of where, within the active airman population, to search for undetected human factors associated with accidents. Author

N71-21853# Federal Aviation Administration, Oklahoma City, Okla. Office of Aviation Medicine.

A DEVICE AND METHOD FOR RAPID INDIRECT MEASUREMENT OF HUMAN SYSTOLIC AND DIASTOLIC BLOOD PRESSURES

Michael T. Lategola and Hiley F. Harrison Dec. 1970 25 p refs

(FAA-AM-70-21) Avail: NTIS

An indirect blood pressure measuring device and method have been evolved for human use. This system is capable of providing 30 measurements each of systolic and diastolic pressures per minute. The system utilizes two brachial blood pressure cuffs (one on each arm) and fully automatic cycling for each pressure measurement. The main advantages of this system are: (1) minimum circulatory impedance during each measurement; (2) the capability of measuring rapid blood pressure transients; and (3) the complete avoidance of all the inherent risks of intra-arterial catheterization. Author

N71-21888# Joint Publications Research Service, Washington, D.C.

BIOCLIMATOLOGY OF CENTRAL ANTARCTICA AND HUMAN ACCLIMATIZATION

I. I. Tikhomirov 10 Mar. 1971 93 p Transl. into ENGLISH from the book "Bioklimatologiya Tsentral'noy Antarktidy i Akklimatizatsiya Cheloveka" Moscow, Nauka Publishing House, 1968 p 76–161

(JPRS-52579) Avail: NTIS

Hygienic and clinical-physiological aspects of living in the polar region are studied. Problems connected with the facility include heating, lighting, and ventilating, and related considerations of clothing, preparation of food and water, and presence of

microflora are described. The effects of living in the polar region on cardiovascular system, respiration, metabolism and thermal regulation, and nervous system are discussed. N.E.N.

N71-21880# Joint Publications Research Service, Washington, D.C.
PSYCHOPHYSIOLOGICAL ANALYSIS OF WORK ACTIVITIES
G. M. Zarakovskiy 30 Mar. 1971 98 p refs Transl. into ENGLISH of the book 'Psikhofiziologicheskiy Analiz Trudovoy Deyatelnosti' Moscow, Nauka, 1968 p 1–114
(JPRS-52752) Avail: NTIS

The procedures for analyzing work processes of the administrative, control type are presented. The method is based on general control theory, or cybernetics, and uses algorithm theory, probability theory, and mathematical logic. Means for obtaining quantitative characteristics of psycophysiological distinctions are described. N.E.N.

N71-21899 Virginia Univ., Charlottesville.
THE CUTANEOUS PERCEPTION OF BINARY PATTERNS
Charles Cedric Hodge (Ph.D. Thesis) 1969 88 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 70-4800

A series of four experiments were performed using both whole and partial reporting techniques to investigate the ability of college students to reproduce binary patterns formed by electrically stimulating the finger tips. The results using the whole report technique indicated that while knowledge of results did not significantly facilitate performance, performance did improve with practice. In addition, evidence was obtained that the subjects given knowledge of results in the complete-report experiment tended to make fewer errors in reporting left-hand stimuli at the expense of making more errors in reporting right-hand stimuli. Evidence that decay of availability of memory to recall was not a major factor was obtained in the one-hand partial-report experiment, in which equating the stimulus-recall interval for the two hands did not significantly change the errors per hand for either hand. This inference is also supported by the fact that report accuracy did not improve in the single-digit partial-report experiment. Dissert. Abstr.

N71-21912# Submarine Development Group 1, San Diego, Calif.
BREATHING IMPEDANCE OF THE MARK 8 AND MARK 11 SEMICLOSED UNDERWATER BREATHING APPARATUS Final Report, Jun. 1969 – Aug. 1970
Mark E. Bradley, James Vorosmarti, Jerry Merz, Paul J. Heckert, and John C. Kleckner 17 Aug. 1970 203 p refs
(AD-717355; RR-1-70) Avail: NTIS CSCL 6/11

A diver breathing with an underwater breathing apparatus will have his ventilatory capability degraded by an inherent breathing impedance in the equipment used. The impedance of both the equipment and the divers respiratory system will increase as ambient pressure increases. There is little information available concerning the deleterious physiological effects imposed on the diver breathing with an underwater breathing apparatus. A paucity of information delineating bioengineering specifications for breathing resistance in underwater breathing apparatus exists. This study was undertaken to measure the breathing resistance encountered by an exercising subject using a semiclosed underwater breathing apparatus. Objectives of the study were: delineation of physiological effects imposed by equipment resistance in the presence of gases of normal and increased density; development of techniques to evaluate breathing resistance in diving equipment; tenative establishment of specifications for engineering design of diving equipment in terms of breathing resistance. All objectives of the study were attained. Author (GRA)

N71-21951 Advisory Group for Aerospace Research and Development, Paris (France).
THE EFFECTS OF GRAVITY AND ACCELERATION ON THE LUNG
D. H. Glaister Slough, Engl. Technision Serv. Nov. 1970 223 p refs
(AGARDograph-133) Copyright. Avail: Issuing Activity

A description is given of the mechanics of the lungs under gravitational and accelerative stresses. The effects upon the cardiovascular system and upon the performance of the lungs, together with the consequential effects are discussed in detail. Some information is provided on the method of increasing tolerance to acceleration. A bibliography and index are included. Author

N71-22001# Joint Publications Research Service, Washington, D.C.
HUMAN PHYSIOLOGY UNDER CLIMATIC CONDITIONS OF THE USSR
11 Mar. 1971 70 p refs Transl. into ENGLISH from the book "Fiziologiya Cheloveka V Prirodnykh Usloviyakh SSSR" Leningrad, Nauka Press, 20 Mar. 1969 189 p
(JPRS-52594) Avail: NTIS

CONTENTS:

1. SEASONAL CHANGES IN THE ORGANISM UNDER FAR EASTERN MONSOON CONDITIONS V. A. Matuykhin p 1–10 refs (See N71-22002 11-04)
2. AGE PECULARITIES OF THERMOREGULATION AND THEIR SEASONAL SHIFTS UNDER HOT CLIMATIC CONDITIONS K. Z. Kafarova p 11–21 refs (See N71-22003 11-04)
3. CERTAIN FEATURES OF ADAPTATION TO HIGH ALTITUDE CONDITIONS IN TRAINED AND UNTRAINED INHABITANTS OF VARIOUS GEOGRAPHIC ZONES M. F. Avazbekiyeva et al p 22–28 (See N71-22004 11-04)
4. PROLONGED ACCLIMATIZATION OF MAN IN THE CENTRAL ASIAN MOUNTAINS M. M. Mirrakhimov p 29–45 refs (See N71-22005 11-04)
5. HUMAN ACCLIMATIZATION AT MEDIUM ELEVATIONS IN THE MALYY KAVKAZ S. M. Bedalova p 48–54 refs (See N71-22006 11-04)
6. PHYSIOLOGICAL FUNCTIONS IN ACCLIMATIZED MAN UNDER CONDITIONS OF KIRGIZIYA AND THEIR SEASONAL SHIFTS L. G. Filatova p 55–68 refs (See N71-22007 11-04)

N71-22002# Joint Publications Research Service, Washington, D.C.
SEASONAL CHANGES IN THE ORGANISM UNDER FAR EASTERN MONSOON CONDITIONS
V. A. Matyukhin *In its* Human Physiol. Under Climatic Conditions of the USSR 11 Mar. 1971 p 1–10 refs (See N71-22001 11-04)
Avail: NTIS

Thermoregulation and basal metabolism were studied in subjects acclimatized to the monsoon climate and in those recently arrived. Specific seasonal and daily differences were noted between the two groups, and also between them and persons in non-monsoon climates. The most significant changes during the monsoon season were a lowering of the level of excitability and functional mobility of the central nervous system. Thermoregulation has seasonal and daily peculiarities. Details are given on the seasonal and daily fluctuations in blood pressure, pulse pressure, and blood composition. N.E.N.

N71-22003# Joint Publications Research Service, Washington, D.C.
AGE PECULIARITIES OF THERMOREGULATION AND THEIR SEASONAL SHIFTS UNDER HOT CLIMATIC CONDITIONS

K. Z. Kaferova *In its* Human Physiol. Under Climatic Conditions of the USSR 11 Mar. 1971 refs p 11–21 (See N71-22001 11-04)
Avail: NTIS

Seasonal variations in thermoregulation were studied in residents in a hot, dry climate (Baku) with respect to age and sex. Measurements were made of pulse rate, blood pressure, respiration, oxygen consumption and carbon dioxide release, energy expenditures, sweating, and skin and body temperatures. Specific differences were noted and are discussed. An overall pattern to age shifts was determined: the thermoregulatory equilibrium in preschool children appears to be inadequate in summer and begins to stabilize in children of the prepuberty age group. N.E.N.

N71-22004# Joint Publications Research Service, Washington, D.C.
CERTAIN FEATURES OF ADAPTATION TO HIGH ALTITUDE CONDITIONS IN TRAINED AND UNTRAINED INHABITANTS OF VARIOUS GEOGRAPHIC ZONES
M. F. Avazbakiyeva et al *In its* Human Physiol. Under Climatic Conditions of the USSR 11 Mar. 1971 p 22–28 (See N71-22001 11-04)
Avail: NTIS

Physiological effects in experienced and novice mountain climbers from northern and southern regions were studied at altitudes between 2600 and 3600 meters above sea level. Measurements were made on the cardiovascular system, oxygen saturation of the arterial blood, changes in stimulation of the respiratory center, EKG, basal metabolism, and pulmonary respiration. More compensatory potentials on the part of the cardiovascular system, respiratory system and basal metabolism were observed among subjects from southern areas under conditions of rest and muscular exertion. This was especially pronounced in southern experienced climbers. N.E.N.

N71-22005# Joint Publications Research Service, Washington, D.C.
PROLONGED ACCLIMATIZATION OF MAN IN THE CENTRAL ASIAN MOUNTAINS
M. M. Mirrakhimov *In its* Human Physiol. Under Climatic Conditions of the USSR 11 Mar. 1971 p 29–45 refs (See N71-22001 11-04)
Avail: NTIS

Physiological responses of persons having lived five years in the Pamirs and of natives were investigated. Measurements were made of hyperventilation, erythrocyte count and hemoglobin, venous pressure, blood flow rate, right ventricular strain, and oxygen consumption. The data show that complete acclimatization to high altitudes is accompanied by the establishment of physiological functions at a new level qualitatively and quantitatively. N.E.N.

N71-22006# Joint Publications Research Service, Washington, D.C.
HUMAN ACCLIMATIZATION AT MEDIUM ELEVATIONS IN THE MALYY KAVKAZ
S. M. Bedalova *In its* Human Physiol. Under Climatic Conditions of the USSR 11 Mar. 1971 p 46–54 refs (See N71-22001 11-04)
Avail: NTIS

Circulation, respiration, and pulmonary gas exchange in permanent residents of medium elevations were studied and found to be considerably intensified. It was found that acclimatization is characterized by definite phases. In the transitional phase there are increases in pulse rate, venous pressure, blood flow rate, cardiac minute and stroke volume, pulmonary ventilation, depth and rate of respiration, and gas exchange, along with decreases in arterial pressure and arterial-venous oxygen differential. The second phase shows incomplete adaptation, and emerges at the end of the second week. The final phase is one of relatively stable adaptation, and changes in most physiological functions become clearly stabilized. N.E.N.

N71-22007# Joint Publication Research Service, Washington, D.C.
PHYSIOLOGICAL FUNCTIONS IN ACCLIMATIZED MAN UNDER CONDITIONS OF KIRGIZIYA AND THEIR SEASONAL SHIFTS
L. G. Filatova *In its* Human Physiol. Under Climatic Conditions of the USSR 11 Mar. 1971 p 55–68 refs (See N71-22001 11-40)
Avail: NTIS

Basal metabolism data on persons 18 to 40 years old are discussed. The climate of the mountainous region is characterized by sharp changes in temperature, illumination, low pressure, and high ionization of air. Details are discussed on blood composition, respiration, thyroid functions, blood pressure, hypoxia, and the lack of correlation between energy metabolism and body temperature. N.E.N.

N71-22115# Naval Medical Research Inst., Bethesda, Md.
GROWTH OF ESCHERICHIA COLI IN HIGH PRESSURE HELIUM OXYGEN GAS ATMOSPHERES
Norbert A. Schlamn and James E. Perry 3 Dec. 1970 11 p refs
(AD-717404; Rept-1) Avail: NTIS CSCL 6/13

Growth of Escherichia coli strain W was accelerated by pressurization to 68 atm (1000 psig) with helium-oxygen gas atmospheres. The acceleration appeared to be related to sequestration of iron and more efficient iron utilization by pressurized cells. Author (GRA)

N71-22151# School of Aerospace Medicine, Brooks AFB, Tex.
STATUS OF PURE-TONE AUDIOMETRY IN USAF HEARING PROGRAMS Final Report, Jul. 1969 - Apr. 1970
Donald S. Gasaway and Harrell C. Sutherland, Jr. Nov. 1970 19 p refs
(AD-717846; SAM-TR-70-68) Avail: NTIS CSCL 6/16

Pure-tone audiometry is used in the U. S. Air Force in support of three testing programs: Audiometric monitoring of persons routinely exposed to potentially hazardous noise; determining compliance with physical examination profiles (entrance into general service and certain career fields and continuance and separation evaluations); and diagnostic evaluations (differential diagnosis and aural rehabilitation). The report provides insight concerning the status of audiometers and autiometry used at USAF medical activities. Major emphasis is given to simple pure-tone audiometry used to monitor the hearing of persons included in the Air Force hearing conservation program and audiometry performed to determine physical profiles. Guidance is provided concerning primary and secondary factors which contribute to errors in autiometry. Author (GRA)

N71-22161 School of Aerospace Medicine, Brooks AFB, Tex.
USE OF MODULATING FUNCTIONS FOR SYSTEM IDENTIFICATION Technical Report, May 1969 - May 1970
Thomas E. Simondi Nov. 1970 37 p refs
(AD-717847; SAM-TR-70-54) Avail: NTIS CSCL 6/16

A major goal of research on physiologic processes is the derivation of a mathematical model of the system under test. With the growth of modern control theory, mathematical methods have been and are being developed to reliably obtain parameters of an estimated system from experimental data. The report investigates the modulating function method of system identification first described by Loeb and Cahen. The method is applicable to systems described by linear differential equations, and tests of the method

show that it is suitable for use with both analytic and operational data. Certain restrictions exist on the method, however. To test the method, a general model of the closed-loop carotid blood pressure control system was derived and tested. Author (GRA)

N71-22203# Joint Publications Research Service, Washington, D.C.

KINEMATIC SWIMMING CHARACTERISTICS OF SOME FAST MARINE FISH

V. Ye. Pyatetskiy *In its* Hydrodyn. Probl. of Bionics 12 Mar. 1971 p 12–23 refs (See N71-22201 11-05)

Avail: NTIS

Data are presented on the swimming speed and kinematics of three Black Sea fish species; bonito, striped mullet, and bluefish. Results were obtained from experimental investigations conducted on a biohydrodynamic unit capable of taking stills and motion pictures of moving objects; determining hydrodynamic resistance and speed; visually observing the kinematics of movement; and conducting energy studies at speeds up to 4 m/sec throughout a requisite time interval. A.L.

N71-22204# Joint Publications Research Service, Washington, D.C.

HYDRODYNAMIC SWIMMING CHARACTERISTICS OF SOME FAST MARINE FISH

V. Ye. Pyatetskiy *In its* Hydrodyn. Probl. of Bionics 12 Mar. 1971 p 24–31 refs (See N71-22201 11-05)

Avail: NTIS

Study of the kinematics and energetics of movement of fast swimming fish and other marine animals, as well as a determination of their hydrodynamic drag, is of considerable practical interest from the viewpoint of applying knowledge gained in hydrobionics to various areas of technology. Some hydrodynamic characteristics of three Black Sea salt water fish are presented in graphical and tabular form. The approximate theory of marine animal swimming mechanism used to calculate these characteristics is a simple and reliable method of evaluating the hydrodynamic efficiency of locomotive organs, particularly the caudal fin. A.L.

N71-22205# Joint Publications Research Service, Washington, D.C.

FREQUENCY CHARACTERISTICS OF AQUATIC ANIMALS

S. V. Pershin *In its* Hydrodyn. Probl. of Bionics 12 Mar. 1971 p 32–36 refs (See N71-22201 11-05)

Avail: NTIS

Analysis of existing experimental data indicates that aquatic forward locomotion of fair duration is with good approximation not only a periodic but harmonic process as well. An aquatic animal's center of gravity moves in almost rectilinear and practically uniform fashion, while the bending oscillations of points on the body surface and tail fin thruster are described by means of simple harmonics. From the standpoint of the theory of mechanical oscillations of rigid bodies, the prolonged forward movement of aquatic animals represents a sustained harmonic oscillation. A system of one and two parameter, dimensional and dimensionless characteristics graphs are proposed to achieve a fuller quantitative description of the swimming mechanism of aquatic animals. A.L.

N71-22206# Joint Publications Research Service, Washington, D.C.

RESONANCE CONDITIONS IN THE SWIMMING OF DOLPHINS

S. V. Pershin *In its* Hydrodyn. Probl. of Bionics 12 Mar. 1971 p 37–43 (See N71-22201 11-05)

Avail: NTIS

It has been demonstrated that during more or less prolonged forward locomotion of a dolphin, with constant regime, the flexing-oscillating motions of the animal's body and flukes are harmonic, whereby the amplitude frequency characteristic curve shows marked resonance, which dolphins adhere to most frequently in sustained swimming. Proof of these features of the swimming mechanism of dolphins was obtained by use of available experimental materials and underwater photography. Results indicate that dolphins do not fear resonance conditions, and that such conditions are normal and useful to these aquatic animals. A.L.

N71-22207# Joint Publications Research Service, Washington, D.C.

PHYSIOLOGICAL SUBSTANTIATION OF GRAY'S PARADOX

O. G. Karandeyeva et al *In its* Hydrodyn. Probl. of Bionics 12 Mar. 1971 p 44–53 refs (See N71-22201 11-05)

Avail: NTIS

The assumed discrepancy between the necessary and real power output of a dolphin, termed Gray's paradox, led to the hypothesis of the existence of mechanisms which effectively reduce drag by laminarizing the boundary layers. Existing data on dolphin experiments were examined in order to evaluate the possibilities and reliability of calculating locomotion power output on the basis of data in literature. Results indicate that adequate experimental data are lacking to substantiate or reject Gray's paradox, and particularly for quantitative evaluation. A.L.

N71-22208# Joint Publications Research Service, Washington, D.C.

BIOLOGICAL EFFICIENCY OF SOME MARINE FISH

L. F. Kozlov *In its* Hydrodyn. Probl. of Bionics 12 Mar. 1971 p 54–56 refs (See N71-22201 11-05)

Avail: NTIS

Biological efficiency is defined as the ratio of mechanical energy expended by a fish in swimming to the energy produced by the organism during locomotion and determined on the basis of oxygen consumption. Analysis of data obtained as a result of theoretical investigations of the bioenergetics and hydrodynamics of marine fish indicates that the biological efficiency of marine fish increases as speed of locomotion increases. A.L.

N71-22209# Joint Publications Research Service, Washington, D.C.

MANEUVERABILITY AND CONTROLLABILITY OF DOLPHINS

M. K. Maslov *In its* Hydrodyn. Probl. of Bionics 12 Mar. 1971 p 57–61 refs (See N71-22201 11-05)

Avail: NTIS

Studies of the swimming of dolphins shows the perfection of their hydrodynamic characteristics and the utility of various adaptations of their organism to the water ambient, adaptations which give these animals high relative speeds and unusual economy of motion from an energetics standpoint. The maneuvering qualities of the dolphin as a hydrodynamic structure attest to the dolphin's superiority over manmade devices. The basic features of the biological implementation of maneuvering, as well as the characteristics of the maneuverability and controllability of dolphins were examined and compared with the performance characteristics of manmade devices. Computations are presented and discussed for a 180 degree turn maneuver for: dolphins; experimental submarine Albacore; and a high speed nuclear submarine of the Skipjack class. A.L.

N71-22210# Joint Publications Research Service, Washington, D.C.

ELEMENTS OF HYDROSTATICS OF DOLPHINS

D. A. Morozov et al *In its* Hydrodyn. Probl. of Bionics 12 Mar. 1971 p 62–67 ref (See N71-22201 11-05)

Avail: NTIS

Hydrostatic factors affecting the diving capabilities of dolphins were investigated. Discussed in detail are: (1) pressure increase on lungs and air sacs during dives; (2) thermoregulation mechanism; (3) hydrostatic pressure effects on body; (4) change of volume of air cavities; and (5) buoyancy. A.L.

N71-22212# Joint Publications Research Service, Washington, D.C.

PROPULSIVE TAIL MUSCULATURE OF THE ATLANTIC COMMON DOLPHIN

G. B. Agarkov et al *In its* Hydrodyn. Probl. of Bionics 12 Mar. 1971 p 77–81 refs (See N71-22201 11-05)
Avail: NTIS

Morphological examinations were conducted to investigate the propulsive muscle functions and nervous system in the tails of common dolphins. The employment of impregnation methods permitted discovery in the region of the tail musculature a great number of various nerve structures in the form of nerve plexus, terminal endings, receptor sensors, and myoneural junctions. The effectiveness of the motor musculature of the back and caudal region of the dolphin was determined in large measure by the features of its attachment to the mastoid and transverse processes of the vertebrae, as well as to the hemal ossicles. The data obtained on innervation of the muscles attest to the presence of direct linkage and feedback between the nerve terminations in the muscles and tendons on the one hand and the central nervous system on the other. Consequently regulation of the functions of the musculature is actively supervised by the central nervous system. A.L.

N71-22213# Joint Publications Research Service, Washington, D.C.

STRUCTURE AND INNERVATION OF THE COMMON INTEGUMENT OF BLACK SEA DOLPHINS IN CONNECTION WITH ITS PROTECTIVE FUNCTION

G. B. Agarkov et al *In its* Hydrodyn. Probl. of Bionics 12 Mar. 1971 refs (See N71-22201 11-05)
Avail: NTIS

The problem of protection of the internal tissues and organs of dolphins during deep dives from the high hydrostatic pressure characteristic of these depths was investigated. The skin performs the primary protective function and during the process of evolution has apparently acquired properties enabling the skin to withstand considerable pressures. The skin of the dolphin consists of three main layers: epidermis; dermis with cutaneous muscle; and subcutaneous fatty tissue. Each layer has its own features and protects the tissues and organs in a different manner and to a different degree. The structure and innervation of each of the three layers is described and discussed. A.L.

N71-22214# Joint Publications Research Service, Washington, D.C.

SOME FEATURES OF THE HISTOSTRUCTURE AND INNERVATION OF THE FRONTAL PROMINENCE OF BLACK SEA DOLPHINS

B. G. Khomenko *In its* Hydrodyn. Probl. of Bionics 12 Mar. 1971 p 89–98 refs (See N71-22201 11-05)
Avail: NTIS

Detailed studies of the morphological peculiarities of the frontal prominence which, it is presently believed, constitutes one of the elements of the dolphin's echo location apparatus were conducted. Results of laboratory studies of the neural structures of the frontal cushion of the harbor porpoise, common dolphin, and bottle-nosed dolphin are presented. A.L.

N71-22215# Joint Publications Research Service, Washington, D.C.

SOME PECULIARITIES OF THE STRUCTURE OF THE SKIN OF SHARKS

O. B. Chernyshov et al *In its* Hydrodyn. Probl. of Bionics 12 Mar. 1971 p 99–107 refs (See N71-22201 11-05)
Avail: NTIS

Histological investigations were made of 32 skin specimens taken from various areas of the spiny dogfish. Results of study of change in placement of the structure of the placoid scales on the shark's body, their quantity per unit of body surface, shapes of spines on various parts of the body surface, quantity and placement of mucus cells on the body, and effects of these elements on producing drag reducing mechanisms are discussed. A.L.

N71-22216# Joint Publications Research Service, Washington, D.C.

PRELIMINARY RESULTS OF A STUDY OF TEMPERATURE DISTRIBUTION OF THE BODY SURFACE OF DOLPHINS

V. V. Babenko et al *In its* Hydrodyn. Probl. of Bionics 12 Mar. 1971 p 108–113 refs (See N71-22201 11-05)
Avail: NTIS

Dolphin skin surface temperature measurements were made with type MT-54 semiconductor microthermistors. The extreme sensitivity of the MT-54 permitted measurements to be made without using an amplifier. The electrical signal from the sensing element was carried by the wires to a measuring bridge and onto an N-700 oscillograph. Skin temperatures were measured on three species of dolphin: common dolphin, bottle-nosed dolphin, and harbor porpoise. A measuring arrangement was used that permitted temperature measurements on the entire body surface. Test data indicate that in a stationary state the temperature difference between the skin surface and the water does not exceed 1 C. Measurements show that the temperature drop between skin surface and water is proportional to the animal's available energy with the temperature differential being greater in a faster specimen. A.L.

N71-22217# Joint Publications Research Service, Washington, D.C.

SONIC ACTIVITY OF THE COMMON DOLPHIN AND HARBOR PORPOISE IN VARIOUS SITUATIONS

A. A. Titov et al *In its* Hydrodyn. Probl. of Bionics 12 Mar. 1971 p 114–122 refs (See N71-22201 11-05)
Avail: NTIS

Results are presented of acoustic investigations conducted on five common dolphins and three harbor porpoises. The specimens were studied by means of monitoring and recording phonations in an 18 × 13 × 2 tank and in a 40 × 8 × 10 meter open air sea water pen. The animals' behavior was observed and sounds in the tank were recorded in a frequency band of 60 Hz-100 kHz. In the pen portable sound equipment was used, with a frequency range of 60 Hz–13 kHz. Acoustical equipment consisted of a set of ceramic hydrophones, amplifiers, sound pressure meter, and tape recorders. Signal analysis was done with a cathode ray tube and loop oscillograph, as well as ultrasonic and audio frequency spectrometers. Observations indicated that the acoustic signals produced by the common dolphin can be divided into four groups: (1) clicks emitted in trains and used for echo location; (2) quacks, squawks, blats; (3) whistles; and (4) other sounds perceived as cries, barking, chirping, smacking, dry twig snapping, laughing, and clanking. Harbor porpoise vocalization activity was much less than that of the common dolphin and bottle-nosed dolphin. A.L.

N71-22240# School of Aerospace Medicine, Brooks AFB, Tex.

RESPONSES IN THE CARDIOVASCULAR SYSTEM OF RATS INTERMITTENTLY EXPOSED TO AN ALTITUDE OF 18000 FEET

Lloyd L. Foster Dec. 1970 19 p refs
(AD-717851; SAM-TR-70-93) Avail: NTIS CSCL 6/19

The study involved a comparison of ground-level rats to rats that were exposed to an altitude of 18,000 feet, six hours a

day, for 5, 10, 15, and 20 days, respectively, in order to determine any differences in the responses of the cardiovascular system. Upon comparison of the two groups, the 10, 15, and 20-day altitude rats showed a significant increase in diastolic pressure and systolic pressure. The 10-day altitude group also had an increase in heart rate. Exposure of rats to an altitude of 18,000 feet, six hours a day for 5 days, showed no changes in the cardiovascular measurements when compared to ground-level rats. Intravenous injection of epinephrine increased blood pressure in all groups of rats; this was more pronounced in the 10, 15, and 20-day ground-level group. The 5-day ground level and altitude groups showed no difference in blood pressure rise after the injection of epinephrine. Author (GRA)

N71-22253# School of Aerospace Medicine, Brooks AFB, Tex.
EFFECTS OF MICROWAVES ON BACTERIA IN FROZEN FOODS Final Report, 15 Sep. 1969 – 23 May 1970
Raymond A. Madson, Joseph T. Cordaro, Ronald L. Koller, and Gary E. Voelker Nov. 1970 13 p refs
(AD-717853; SAM-TR-70-87) Avail: NTIS CSCL 6/8

The effects of freezing and microwave heating on deliberately contaminated precooked frozen meal components were studied. Freezing conditions and food type appeared to influence survival of Escherichia coli as time increased, but Streptococcus faecalis exhibited no apparent change. Twenty-seven groups of samples representing 17 different foods were analyzed. The results suggest that the microwave heating will satisfactorily kill or reduce incidental and introduced microorganisms to a safe level providing the microwave exposure time is correlated with the size and type of food substance being treated. Author (GRA)

N71-22254# Wisconsin Alumni Research Foundation, Madison.
NUTRIENT ANALYSIS OF AEROSPACE FOODS Final Report, Sep. 1966 – Feb. 1969
Jerry L. Moore, Roy E. Chapin, and John E. Vanderveen Brooks AFB, Tex. School of Aerospace Med. Nov. 1970 18 p refs
(Contract F41609-68-R-0026)
(AD-717859; SAM-TR-70-75) Avail: NTIS CSCL 6/8

Concentrations of energy, fat, nitrogen, chloride, and the cations of 14 different metallic elements were measured in 219 samples of 74 space food items. Although the compiled data do not permit calculation of standard values, this tabulation will be a useful reference for those interested in the nutritive quality of state-of-the-art, space-type food items. Author (GRA)

N71-22289# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
EFFECTS OF SHORT-TERM LOW LEVEL CARBON MONOXIDE EXPOSURE ON HUMAN PERFORMANCE Final Report, Feb. – Aug. 1969
Robert D. O'Donnell, Peter Mikulka, Patrick Heinig, and James Theodore Jun. 1970 59 p refs
(AD-717716; AMRL-TR-70-37) Avail: NTIS CSCL 6/20

The effects of 0, 50, 125, 200, and 250 ppm of carbon monoxide exposure on human time estimation, tracking, ataxia, galvanic skin response and heart rate were tested in 10 subjects. Mean carboxyhemoglobin levels from .96 to 12.37% were reached after 3 hours of exposure. No significant symptoms were reported by subjects, and no ability to detect the presence of CO was noted. No overall trend toward poorer estimates of a 10 second interval occurred as a function of CO uptake, and tracking performance did not become worse over the course of the exposure to CO. There were some indications that subjects under CO showed a different overall pattern of tracking over time than control subjects in that their performance curve was flatter. However, this observation must be considered tentative. No changes in absolute heart rate occurred during task performance in any group, but there was slightly less cardiac deceleration at the onset of a task in the CO groups during early exposure. No differences in galvanic skin response were found between any groups. It is concluded that the present data do not support the hypothesis that low level carbon monoxide exposure results in human performance decrements. Additional investigation is required to define the lower limit, and extent of such exposure to resolve major conflicts in the literature. Author (GRA)

N71-22347# Missouri Univ., Columbia. Space Sciences Research Center.
EFFECTS OF HYPEROXIA ON COMPOSITION AND RATE OF SYNTHESIS OF FATTY ACIDS IN ESCHERICHIA COLI
Olen R. Brown, Harvey F. Howitt, Jack L. Stees, and Wesley S. Platner Jan. 1971 34 p refs
(Contract N00014-67-A-0287-0002)
(AD-717673; TR-1) Avail: NTIS CSCL 6/1

Growth and fatty acid synthesis in Escherichia coli were inhibited by oxygen at partial pressures above one atmosphere, and were prevented by exposure to oxygen at 4.2 atmospheres on membranes incubated on a minimal medium. Growth and fatty acid synthesis returned to control rates when cells were removed from hyperoxia to air. The spectrum of fatty acids produced was unchanged by oxygen at pressures which reduced the rate of synthesis. In situ fatty acids were stable to oxygen at pressures which prevented growth and synthesis. Reinitiation of synthesis following complete inhibition in hyperoxia occurred without production of aberrant fatty acids. Fatty acid synthetase specific activity was virtually unchanged, compared to air controls, in cells exposed either to 3.2 or to 15.2 atmospheres of oxygen. The spectrum of fatty acids synthesized by cell-free extracts during incubation in 4.2 atmospheres of oxygen was not different from air incubated controls. Synthetase assays included added NADPH, acyl carrier protein, mercaptoethanol and malonyl coenzyme A; hence, only damage, other than reversible sulfhydryl oxidation, to the apoenzymes of synthetase was ruled out. Author (GRA)

N71-22451# Aerospace Medical Div. Aeromedical Research Lab. (6571st), Holloman AFB, N.Mex. Bio Effects Div.
DEPARTMENT OF TRANSPORTATION DAISY TRACK HUMAN TOLERANCE TEST Final Report
Charles D. Bendixen Jun. 1970 15 p
Avail: NTIS

An impact test program to compare and evaluate lap belt vs lap belt plus air cushion restraints was conducted. Tests included both human and baboon subjects. The human tests are described. The purpose of the entire study was to provide statistically significant comparisons of the effectiveness of various restraint systems, including air bag restraints during impact conditions. For the human portions covered by this report, a separate purpose was stated to compare man's subjective tolerance levels during impact using the following restraint systems: (1) lap belt; (2) lap belt plus air bag. The experimental approach as specified in the work statement called for subjecting five human subjects to increasingly severe impacts in each of the two restraint configurations being compared until in the subject's (subjective tolerance) or the medical monitor's opinion the testing of either of the two restraint configurations in question should be terminated. Testing with the other restraint was to be continued until a similar level was reached. Tolerance levels would then be compared. Author

N71-22508*# Techtran Corp., Glen Burnie, Md.
VARIATION IN THE PHOSPHOLIPID CONTENT OF E COLI CELLS DURING THEIR CHANGE INTO SPHEROPLASTS [MODIFICATION DE LA CONSTITUTION EN PHOSPHOLIPIDES DES CELLULES D'E COLI PENDANT LEUR TRANSFORMATION EN SPHEROPLASTES]
M.-C. Simmler et al Washington NASA Feb. 1971 15 p refs Transl. into ENGLISH from Ann. Inst. Pasteur (Paris), v. 119,

1970 p 289-301
(Contract NASw-2037)
(NASA-TT-F-13488) Avail: NTIS CSCL 06A

Cells of E. Coli cultivated in the presence of penicillin and saccharose change into spheroplasts, during which the phospholipid content is modified. There is a gradual increase in the proportion of lysophosphatidylethanolamine (LPE) and diphosphatidylglycerol (DPG) and a decrease in the proportion of phosphatidylethanolamine (PE) and phosphatidylglycerol (PG). The phospholipases responsible for the formation of LPF from PE show increased activity with a fall in the osmotic pressure of the medium. The proportion of LPE increases even in the presence of low concentrations of penicillin. When the spheroplasts undergo a mechanical treatment, centrifugation and resuspension, there is a definite increase in LPE. The proportion of LPE increases each time that the cells suffer attack: a raised quantity of LPE is the sign of initiation of irreversible processes. On the other hand, the increase of DPG is reversible under certain conditions, which is significant as a defense mechanism because DPG (by the nature of its structure) can strengthen the membrane. The quantity of DPG varies in an opposite way to the other cell-synthesized products, which indicates that it plays a regulating role. Author

N71-22557*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Propulsion Div.
CYANATE ION AND THE UREMIC SYNDROME
J. D. Ingham *In its* JPL Quarterly Tech. Rev., Vol. 1, No. 1 Apr. 1971 p 45-48 refs (See N71-22551 11-30)
Copyright. Avail: NTIS HC $6.00/MF $0.95 CSCL 06P

A critical survey is made of the literature that logically provides an hypothesis that relates the symptoms of kidney failure (uremic syndrome) to the presence of cyanate ion derived from metabolic urea. If the hypothesis can be unequivocally verified, the consequences will provide a solution to the problem of defining the primary toxic factor in uremia and should lead to substantial improvements in the available treatment for patients with kidney failure. Author

N71-22976*# Texas Univ., Dallas. Southwestern Medical School.
TEMPERATURE DISCRIMINATION, BEHAVIORAL THERMOREGULATION AND RELATED MEASURES IN THE RAT Final Report
James P. Lipton [1971] 9 p
(Grant NGR-44-012-079)
(NASA-CR-117851) Avail: NTIS CSCL 06C

CONTENTS:

1. HYPERTHERMIA INDUCED BY DIRECT INJECTIONS OF CARBACHOL IN THE ANTERIOR HYPOTHALAMUS D. D. Avery 4 p refs (See N71-22977 11-04)

2. EFFECTS OF DESALIVATION OF BEHAVIORAL THERMOREGULATION AGAINST HEAT J. M. Lipton and D. R. Marotto 5 p refs (See N71-22978 11-04)

3. EFFECTS OF HIGH FAT DIETS ON CALORIC INTAKE, BODY WEIGHT, AND HEAT ESCAPE RESPONSES IN NORMAL AND HYPERPHAGIC RATS J. M. Lipton 9 p refs (See N71-22979 11-04)

4. DETERMINANTS OF BEHAVIORAL THERMOREGULATION AGAINST HEAT: THERMAL INTENSITY AND SKIN TEMPERATURE LEVELS J. M. Lipton, D. D. Avery, and D. R. Marotto 6 p refs (See N71-22980 11-04)

N71-22977*# Texas Univ., Dallas. Div. of Psychology.
HYPERTHERMIA INDUCED BY DIRECT INJECTIONS OF CARBACHOL IN THE ANTERIOR HYPOTHALAMUS
D. D. Avery *In its* Temp. Discrimination, Behavioral Thermoregulation and Related Meas. in the Rat 1971 4 p refs (See N71-22976 11-04)
Avail: NTIS CSCL 06P

Microinjections of carbachol in the anterior preoptic hypothalamic area in rats was found to induce hyperthermia. The magnitude of the injection effects was dose dependent, and the results were associated with intraventricular injections of acetylcholine. Author

N71-22978*# Texas Univ., Dallas. Southwestern Medical School.
EFFECTS OF DESALIVATION ON BEHAVIORAL THERMOREGULATION AGAINST HEAT
James M. Lipton and Daniel R. Marotto *In its* Temp. Discrimination, Behavioral Thermoregulation and Related Meas. in the Rat 1971 5 p refs Repr. from Physiol. Behavior (England), v. 4, 1969 p 723-727 (See N71-22976 11-04)
Avail: NTIS CSCL 06P

Male and female rats made subtotally desalivate by section of the major saliva ducts were tested in operant thermoregulation sessions. This surgery, which impairs a major thermoregulatory response in the rat, produced a rise in operant behavior to reduce heat exposure among the male animals. Through this increased responding, the reduction in evaporative heat loss following desalivation was compensated somewhat, allowing postsession temperatures to be maintained at the normal presurgery levels. Female desalivates did not show an increase in responding. Another effect beneficial in coping with heat stress, the lowering of presession body temperature, emerged among both experimental and control animals in the post operative sessions. The earlier finding of stable post session body temperatures (38.0-39.0 C) in normal animals when this variable is under behavioral control was also noted in the animals of this experiment. Author

N71-22979*# Texas Univ., Dallas. Southwestern Medical School.
EFFECTS OF HIGH FAT DIETS ON CALORIC INTAKE, BODY WEIGHT, AND HEAT ESCAPE RESPONSES IN NORMAL AND HYPERPHAGIC RATS
James M. Lipton *In its* Temp. Discrimination, Behavioral Thermoregulation and Related Meas. in the Rat 1971 9 p refs Repr. from J. Comp. Physiol. Psychol., v. 68, no. 4 p 507-515 (See N71-22976 11-04)
(Contract NIH 5-S01-FR-5426-05)
Avail: NTIS CSCL 06P

Animals made hyperphagic through hypothalamic lesions showed characteristic changes in body weight and alterations in heat-escape response which were related to increases and decreases in the body weight measures. The increased response in both normal and hyperphagic rats is interpreted to be behavioral compensation for restricted body heat loss resulting from increments in depot fat insulation. Author

N71-22980*# Texas Univ., Dallas. Medical School.
DETERMINANTS OF BEHAVIORAL THERMOREGULATION AGAINST HEAT THERMAL INTENSITY AND SKIN TEMPERATURE LEVELS
James M. Lipton, D. D. Avery, and D. R. Marotto *In its* Temp. Discrimination, Behavioral Thermoregulation and Related Meas. in the Rat 1971 6 p refs Repr. from Physiol. Behavior (England), v. 5, 1970 p 1083-1088 (See N71-22976 11-04)
Avail: NTIS CSCL 06P

To elucidate the factors controlling thermoregulatory behavior, two experiments were conducted using rats trained to escape heat by holding down a lever. In both experiments, the time spent responding was found to increase in a monotonic fashion as thermal intensity was increased. Determination of the behavioral response was explored by recording dorsal skin temperature at the moment when a response was begun and when it was terminated. In a neutral environment (23 C), a relatively stable level of skin temperature was maintained in the face of intensity alterations as a result of the changes in behavior. A qualitatively similar result was also seen when the animals were tested in a hot environment (32 C). These findings are consistent with the results of previous

heat reinforcement experiments which have indicated a peripheral basis for the control of thermoregulatory behavior. In the cold (5 C), raising intensity brought about a linear increase in response and in the skin temperature. Author

N71-23056 Institut Marey, Paris (France).
PRINCIPLES OF INFORMATION PROCESSING IN LIVING SYSTEMS [PRINCIPES DU TRAITEMENT DE L'INFORMATION PAR LES SYSTEMES VIVANTS]
A. E. Fessard *In* AGARD Principles and Pract. of Bionics 1968 p 59-72 refs In FRENCH; ENGLISH summary (See N71-23053 11-05)
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The general principles governing information processing in living systems are the same as those operating in man made machines, invented for practical purposes; but more than in any artificial machine, in living organisms these informational systems work at different organization levels, from organic molecules to individuals as a whole, passing through cellular and systemic levels; and there is constant interplay between these different levels. Different combinations of symbols play an effective role in executing specific programs: programming of enzyme action, processes of ontogenesis directed by the genetic code; immunological reactions, programming of motor behavior controlled by the central nervous system, programming of mental evocations, verbal expressions of an emotional or cognitive content. Reliable transmission of messages is only part of the function of biological systems and the best model of information processing in biology is most often that of pattern recognition. Author

N71-23057 Edinburgh Univ. (Scotland). Dept. of Machine Intelligence and Perception.
INFORMATION PROCESSING IN BIOLOGICAL AND ARTIFICIAL BRAINS
R. L. Gregory *In* AGARD Principles and Pract. of Bionics 1968 p 73-80 ref (See N71-23053 11-05)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

It is argued that behavior is not (except in primitive reflexes) controlled directly by sensory information, but rather that sensory information is used to select from the repertoire of stored models which themselves control behavior, though the available information is transitory and, for direct control, inadequate. The models allow prediction of the immediate future, which is vital for planned behavior and reduces reaction or computing time to zero. The classical visual distortion illusions are discussed in these terms - it is supposed that the perceptual models are scaled to fit the distances and sizes of surrounding objects by sensory information in real time - the scaling being inappropriate in atypical situations when the normal assumptions do not hold that the systematic distortions are generated. Distortion and other perceptual phenomena are used to infer the structure of the internal models and assumptions which are expected to allow but little information to control elaborate behavior. Author

N71-23063 Edinburgh Univ. (Scotland). MRC Speech and Communication Research Unit.
CEREBRAL MECHANISMS OF SPEECH
R. C. Oldfield *In* AGARD Principles and Pract. of Bionics 1968 p 197-207 refs (See N71-23053 11-05)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

There is a difference between the form of speech and its linguistic content. Damage to the cortical centers usually produces damage at the linguistic level - meaning semantics and syntactics; whereas damage to other parts of the nervous system tends to produce disturbances in the form of speech - loudness, intonation, stress, timing, speed and phonemic formation. This generalization is not watertight however, as, for instance, patients with lesions in the neighborhood of Broca's area show disturbed articulation, rhythm and phonemic distortion. It is postulated that the cerebral speech apparatus may be divided into two parts: the cortical centers which are similar to a set of interconnected computers, storing, analyzing and collating, encoding and decoding and making up sentences, and the centers of basal ganglia, whose functions include regulation of tone, loudness, stress and rhythm of speech. In addition to the many internal connections the speech mechanisms include a feedback connection to the ear. Because of its accessibility, it has been the basis of several experiments. These have shown that an extra delay of 1/4 second introduced in the loop will profoundly affect articulation and continuity of speech in many people. Author

N71-23064 Ecole Pratique des Hautes Etudes, Paris (France). Directeur de Laboratoire d'Electronique.
PROCESSING AND RECOGNITION OF SPEECH [TRAITEMENT ET RECONNAISSANCE DE LA PAROLE]
L. Pimonow *In* AGARD Principles and Pract. of Bionics 1968 p 209-229 refs In FRENCH; ENGLISH summary (See N71-23053 11-05)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The discussion is first centered on the pattern and information recognition theory, and the sum of information involved in the classification of sound giving objects is evidenced. Then, based on the assumption that the organ of hearing represents a perfect system of acoustical information processing, a parallel and comparative analysis of the mechanism of hearing and of the various technical systems is made. In particular, attention is drawn to the number of data caught by the ear and especially the number of differential frequency, amplitude and duration levels, and to the progressive reduction of these data which is performed in the course of information processing by the ear. The time variation of the information rate imposed by the physiological properties of the ear is also discussed, as well as the relation between this rate variation and intelligibility. Then the differences between sound recognition and word recognition are stressed, together with the determining importance of transitory phenomena. Author

N71-23073*# Massachusetts Inst. of Tech., Cambridge.
FUNCTIONS OF THE VESTIBULAR SYSTEM IN HUMAN GUIDANCE AND CONTROL
L. R. Young *In* AGARD Principles and Pract. of Bionics 1968 p 389-407 refs (See N71-23053 11-05)
Grants NSG-577; NGL-22-009-156; Contract AF 33(615)-5038)
(NASA-CR-117808) Copyright. Avail: NTIS; Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido) CSCL 06P

A physical analog model of the vestibular system was developed that consists of a three gimbal head containing three rate gyroscopes and six linear accelerometers, and a special purpose analog computer simulating the dynamics and nonlinearities of the non-auditory labyrinth. The vestibular package can be rotated through normal head movements by the machine and mounted on a centrifuge or flown to measure actual motion inputs. The distance between the ears is adjustable, as well as the orientation of the sensitive direction of each canal and otolith axis. The computer console permits adjustment of the important gains, nonlinearities and time constants of the vestibular system for utility in refining models, training physiologists, predicting orientation perception or nystagmus and for aids in design of moving base simulators or artificial gravity platforms. Author

N71-23079 Free Univ. of Brussels (Belgium). Solvay Inst. of Physiology.
THE SIMULATION OF THE HEART'S ELECTRICAL GENERATOR SYSTEM, APPENDIX 1
P. Rijlant *In* AGARD Principles and Pract. of Bionics 1968 p 475–484 (See N71-23053 11-05)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The quantitative appraisal of the electrical activity of the human heart is reported. One of the more promising approaches has been the simulation of the electrical generator system of the heart by dipolar or multidipolar generators, these generators being continuously controlled by the actual generator system in the heart. The fundamental principle involved is the continuous comparison of the heart's and the artificial generator systems, the difference signals being continuously utilized to modify and control the artificial generator. The only satisfying equilibrium condition of the system is the near identity of the natural and the artificial generators. Author

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N71-21900# Swift and Co., Chicago, Ill. Research and Development Center.
FABRICATION OF FOOD BARS BASED ON COMPRESSION AND MOLDING MATRICES Final Report, 23 Sep. 1968 – 22 Sep. 1969
Robert L. Pavey Jun. 1970 39 p
(Contract DAAG17-67-C-0068)
(AD-717289; USA-NLABS-TR-70-67-FL) Avail: NTIS CSCL 6/8

Dried foods, some plasticized to prevent fragmentation, were compressed with appropriate binders into bars of approximately equal size, density and caloric content. Bars representing the following food items were designed, formulated, fabricated and evaluated for physical, chemical and sensory characteristics after storage for 3 months at 38C: (1) Citrus Fruit Drink (2) Hot Chocolate Beverage (3) Cream of Mushroom Soup (4) German Potato Salad (5) Cole Slaw (6) Pineapple-Cottage Cheese Salad (7) Welsh Rarebit (8) Crab Meat Cocktail (9) Chocolate Pudding (10) Pineapple Fruit Pudding. Complete information on all formulations and processing is supplied. In accordance with design requirements bars were rated by a taste panel as acceptable for consumption from the dry-compressed state and for consumption after rehydration for 20 minutes in water at 70C. (25C for items consumed at room temperature.) Bars were evaluated for cohesiveness, dimensional stability under pressure, ease of shear by the incisors and subsequent mastication. Observations on free fatty acids, peroxide value and browning (fluorescence units) are recorded for each bar at the time of fabrication and after the referenced storage. Author (GRA)

N71-21913# Naval Aerospace Medical Inst., Pensacola, Fla. Research Lab.
COMPARISON OF TRACKING TASK PERFORMANCE AND NYSTAGMUS DURING SINUSOIDAL OSCILLATION IN YAW AND PITCH
Alan J. Benson (Royal Air Force Inst. of Aviation Med.) and Fred E. Guedry, Jr. Oct. 1970 25 p refs Prepared in cooperation with Army Aeromedical Res' Lab.
(AD-717596; NAMRL-1123; USAARL-71-12) Avail: NTIS CSCL 6/16

The problem was to compare performance limits and nystagmus induced by angular accelerations about the pitch and the yaw axes. Sinusoidal torsional oscillation degraded subjects performance of a compensatory tracking task because inappropriate nystagmic eye movements impaired visibility of the display. Responses to angular oscillation in yaw and pitch were compared. During angular motion in the pitch-forward direction the nystagmus frequency and slow phase velocity, and the consequent performance decrement, were significantly greater than during the pitch-back half cycle. No such asymmetry was found during oscillation in yaw where the nystagmus measures and error scores were similar to those obtained in the pitch-back half cycle. The poorer suppression of vestibular nystagmus during pitch-forward motion is attributed to the higher frequency and smaller amplitude of downbeating nystagmus. Angular oscillation in pitch induced motion sickness more rapidly than a comparable yaw-axis stimulus. This was probably caused by differences in the dynamic response of vertical and lateral canals and the greater mismatch of canal and gravireceptor signals during oscillation in pitch. Author (GRA)

N71-21926*# Welson (B.) and Co., Inc., Hartford, Conn.
HANDBOOK OF GARMENT AND ACCESSORY SYSTEMS SELECTION CRITERIA FOR A SPACE STATION
Nov. 1970 247 p refs
(Contract NAS9-10407)
(NASA-CR-114953; BW-221) Avail: NTIS CSCL 06Q

The criteria by which crew garment systems, garment support systems, and space vehicle accessory items may be evaluated for use in a space station are presented. The handbook is not intended for use as the absolute criteria for design, rather, it is to familiarize persons of engineering discipline with the methodology and rationale involved. In addition to presenting basic data on fabric technology, garment construction, thermal aspects of clothing, laundry systems, and vehicle interface and logistics considerations, appendices have been included that present an illustrative example of how to apply the data contained in the handbook to systems selection; contains a glossary of terms most commonly used in textile technology; defines a method of size clothing and presents current astronaut/scientist population sizing data, and fabric characteristics in selecting fabric items for space station use. Author

N71-22065# Joint Publications Research Service, Washington, D.C.
BIONICS AS APPLIED TO ANALYTICAL RESEARCH
E. T. Gaynullina *In its* Atmospheric Studies at Chem. Enterprises 9 Mar. 1971 p 153–169 refs (See N71-22055 11-13)
Avail: NTIS

Bionics research reviewed includes the use of enzymes to investigate toxic compounds and the simulation of the olfactory system of animate organisms. The bionics model of the olfactory system is applicable in the analysis of industrial air pollution. E.C.

N71-22130# Dayton Univ. Research Inst., Ohio.
RESEARCH ON A DISTRIBUTED PARAMETER MATHEMATICAL MODEL OF THE HUMAN BODY IN DYNAMIC MECHANICAL ENVIRONMENTS Final Technical Report, 16 May 1969 – 15 May 1970
Horst E. Krause and Mehdi Shirazi Dec. 1970 152 p refs
(Contract F33615-69-C-1681)
(AD-717784; UDRI-TR-70-47; AMRL-TR-70-113) Avail: NTIS CSCL 6/2

The report presents a literature survey of the present state of the art of lumped and distributed parameter models of the human body. Modeling techniques using elastic and viscoelastic media are considered. It is concluded that lumped parameter models of an increased number of degrees-of-freedom are necessary to improve model quality. Computer programs are presented that should simplify such an effort. In particular, the numerical values of

the system parameters can be determined with greater accuracy. The partial development of a multi-degree-of-freedom model is demonstrated. The extensive use of the mentioned computer programs should result in considerably more complex models than are available now. No whole-body distributed parameter models have been proposed in the literature. Existing models represent mainly skeletal sections such as the spinal column. A model of the spinal column is proposed in this report that considers the discontinuity in bending stiffness between the lumbar and thoracic spine and the curvature of the lumbar spine. This type of model appears to be very promising because it seems to explain some observed effects attributed to nonlinear properties. It is also recommended that research be initiated to develop hybrid models, that is, models consisting of both lumped parameter and distributed parameter sections. Author (GRA)

N71-22201# Joint Publications Research Service, Washington, D.C.

HYDRODYNAMIC PROBLEMS OF BIONICS

12 Mar. 1971 160 p refs Transl. into ENGLISH of Bionika (Kiev), no. 4, 1970 p 3–120

(JPRS-52605) Avail: NTIS

The articles presented pertain to the general hydrodynamics of aquatic animals; the possibilities of applying telemetry devices to study the boundary layer on a live dolphin; qualitative information on the structure of dolphins and fish; and traveling wave problems. For individual titles, see N71-22202 through N71-22221.

N71-22255# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

AEROSOL BEHAVIOR IN HIGH PRESSURE ENVIRONMENTS Annual Report, 1 Mar. 1970–15 Jan. 1971

Robert A. Gussman and Anthony M. Sacco 15 Jan. 1971 20 p refs

(Contract N00014-69-C-0228)

AD-717733; BBN-2070; AR-3) Avail: NTIS CSCL 6/11

The report details further efforts on filtration experimentation in the high pressure environment. Additional theory relevant to high pressure filtration has been uncovered in the open literature and is presented and discussed. Experimental apparatus for the study of liquid aerosol generation in the high pressure environment has been constructed and operated. The results indicate mild increase in particle size with increasing pressure. There is no intention to purposely form a liquid aerosol in the high pressure environment, but there is always a possibility that the accidential juxtaposition of liquids and mechanical forces will produce liquid aerosols. It is thus necessary to have some base line techniques available for potential toxicological investigations. Author (GRA)

N71-22270*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EVALUATION OF SEVERAL TV DISPLAY SYSTEMS FOR VISUAL SIMULATION OF THE LANDING APPROACH

Wendell D. Chase Washington Mar. 1971 44 p refs

(NASA-TN-D-6274; A-3286) Avail: NTIS CSCL 05H

A study was conducted to determine the effect of several variations of two types of visual display systems on subjective pilot evaluations and objective measures of performance in the landing approach. Two types of flight approaches were made with either a projector or quasicollimated monitor visual display: (1) the instrument approach, and (2) the visual approach without the normal cockpit instrumentation assistance. The variables examined were color; differences between displays due to quasicollimation of the monitor display; and reduced resolution as related to brightness, contrast, and sharpness. The pilots were more critical of the black and white variation for either display, and favored more use of a color system. Advantages cited for a color system included greater pilot relaxation, decreased fatigue, better picture quality, and more realistic depth perception, particularly with the monitor display. With regard to the reduced-resolution monitor display, the pilots also noted a loss in depth perception and height references, increased visual fatigue, and increased efforts for a reasonable approach in comparison with the projector display. The objective performance measures of the study were reasonably consistent with the pilots' subjective evaluations and comments. Author

N71-22301# Advisory Group for Aerospace Research and Development, Paris (France).

PHYSICAL FITNESS IN FLYING INCLUDING THE AGING AND AGED AIRCREW

H. W. Kirchhoff, ed. Mar. 1971 173 p refs Presented at the Specialist Meetings of the Aerospace Med. Panel of AGARD, Garmisch Partenkirchen, West Germany, 21–22 Sep. 1970

(AGARD-CP-81-71) Avail: NTIS

Physical fitness and pilot performance in connection with physiological training are considered. A variety of the symptoms of the aging process are described and their effects on the performance of flying personnel are considered. For individual titles see N71-22302 through N71-22321.

N71-22302# Clemenshospital, Muenster (West Germany).

PHYSICAL FITNESS AND FLYING

Alfred Koch *In* AGARD Phys. Fitness in Flying including the Aging and Aged Aircrew Mar. 1971 16 p refs (See N71-22301 11-05)

Avail: NTIS

The term fitness is described and defined as a state which characterizes the degree to which the human organism is able to function. Measurements of physical fitness aptitude and of the factors that impair or improve fitness are discussed in relation to flying aircrews. G.G.

N71-22303# Institute of Aviation Medicine, Fuerstenfeldbruck (West Germany).

METHODS OF MEASURING PHYSICAL FITNESS

H. W. Kirchhoff *In* AGARD Phys. Fitness in Flying including the Aging and Aged Aircrew Mar. 1971 5 p (See N71-22301 11-05)

Avail: NTIS

Single stage, non-steady state, submaximal exercise procedures are commonly used in diagnostic and functional testing. The principal modes of imposing the workload are step climbing, bicycle ergometer riding and treadmill walking. These tests are generally available and safe. Despite many real and hypothetical deficiencies, they may yield, when standardized, qualitative and quantitative information of considerable value to individual clinical evaluations and to group comparisons. Steady state submaximal exercise tests determine a great number of values (V sub O2, V sub CO2, RQ, V sub E, specific ventilation, oxygen pulse, pulse rate, blood pressure and the ECG). Vita maxima tests are utilized to determine the maximum values of oxygen consumption and the physical working capacities. Author

N71-22304# Army Research Inst. of Environmental Medicine, Natick, Mass. Military Ergonomics Lab.

PHYSICAL FITNESS, FLIGHT REQUIREMENTS AND AGE

Ralph F. Goldman *In* AGARD Phys. Fitness in Flying Including the Aging and Aged Aircrew Mar. 1971 9 p refs (See N71-22301 11-05)

Avail: NTIS

Muscular strength, cardio-respiratory capacity and relative body weight are frequently used criteria of physical fitness. These different aspects of fitness all alter predictably with age and can be altered by training. Considering the physical work involved in flight, it seems appropriate to consider to what degree physical fitness -- and which aspects of it -- should be important to an aircrew. Excess weight may require premature replacement of an

individual because of the decreased longevity associated with being overweight, but should not hinder flight performance as long as the man fits into his workspace, and agility and reach are unimpaired. The energy cost of flying only averages 125 kcal/hr and even an average 65 year old in fair condition has a maximum work capacity at least 3 times that. Finally, the muscular forces required to fly modern aircraft are minimized by electro-mechanical control systems. Author

N71-22305# Canadian Armed Forces Inst. of Environmental Medicine, Toronto (Ontario).

PHYSICAL FITNESS AS PART OF AIRCREW TRAINING

C. L. Allen *In* AGARD Phys. Fitness in Flying Including the Aging and Aged Aircrew Mar. 1971 9 p (See N71-22301 11-05)

Avail: NTIS

Physical fitness development of aircrew candidates in the Canadian Forces is an integral part of their training. Schedules have been established and promulgated for all levels of training from newly enrolled cadets to the advanced flying school stages. While all of the standard elements of physical conditioning, such as calisthenics, resistance training and sports activities are included, the emphasis is on cardio-respiratory development. Regular assessments of candidates are carried out, using the 12-minute distance as the vehicle for testing. All personnel are expected to maintain a good category, i.e. at least 1.50 miles in 12 minutes for ages under 30 years with a suitable reduction for older candidates. Author

N71-22306# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Bad Godesberg (West Germany). Institut fuer Flugmedizin.

PHYSICAL TRAINING STATUS IN RELATION TO STRESS TOLERANCES

H. M. Wegmann and K. E. Klein *In* AGARD Phys. Fitness in Flying Including the Aging and Aged Aircrew Mar. 1971 11 p refs (See N71-22301 11-05)

Avail: NTIS

The influence of physical fitness on stress tolerance was studied by comparing two different groups of subjects, one group including 11 highly trained athletes and the other group consisting of 11 untrained and unadapted students. Both groups were uniformly subjected to hypoxia, acceleration, exercise, and orthostatic stress, applying maximal loads for evaluating tolerances and submaximal loads for studying cardiovascular and hormonal stress responses. In summarizing the results the following conclusions were obtained: A better physical fitness does not imply higher tolerances to stressors other than exercise. There is no indication which supports the idea of an improvement of human tolerance to environmental extremes by physical exercise training. Author

N71-22307# German Air Force, Porz-Wahn (West Germany).

PHYSICAL CONDITIONING TRAINING AND FITNESS TEST OF GERMAN AIR FORCE AIRCREWS

W. Hill *In* AGARD Phys. Fitness in Flying Including the Aging and Aged Aircrew Mar. 1971 7 p ref (See N71-22301 11-05)

Avail: NTIS

Physical conditioning training and fitness tests for German Air Force flying crews are considered as an alternative to the United States of America's Aerobics Physical Fitness Program. The purpose of both programs is to improve the physical conditions of aircrew members until the levels of optimum fitness are attained and thereafter to maintain these high levels for as long as possible. There are, however, essential differences in the application of the two methods. Author

N71-22308# Army Personnel Research Establishment, Byfleet (England).

EXERCISE TOLERANCE OF MILITARY PERSONNEL

M. F. Haisman *In* AGARD Phys. Fitness in Flying Including the Aging and Aged Aircrew Mar. 1971 6 p refs (See N71-22301 11-05)

Avail: NTIS

The exercise tolerance of British Army personnel has been investigated by means of estimates of maximal oxygen intake (Vo2 max.) and the Harvard step test. Vo2 max. was estimated from heart rates, recorded during performance of standardized exercises on stepping stools or bicycle ergometers. About 650 men have been included in the study. The results have indicated that estimated Vo2 max. provided an index of fitness suitable for application to large groups of men, in that it was reproducible, and sensitive in respect of separating groups of trained and untrained men and in detecting the improvements in fitness associated with intensive physical training. The Harvard step test results were of broadly similar pattern to the Vo2 max. results but reproducibility was poorer. Men with a high body fat content showed a marked tendency to have a low Vo2 max. Author

N71-22309# Strasbourg Univ. (France). Inst. Dentaire.

AERONAUTICAL FACTORS AND TOOTHACHE INCIDENCES DURING FLIGHT [FACTEURS AERONAUTIQUES ET INDIVIDUELS DES DOULEURS DENTAIRES EN VOL]

R. Frank, J. M. Debruge, and A. M. Pfister *In* AGARD Phys. Fitness in Flying Including the Aging and Aged Aircrew Mar. 1971 8 p refs In FRENCH; ENGLISH summary Prepared jointly with Centre d'enseignement et de Rech. de Med. Aeron. (See N71-22301 11-05)

Avail: NTIS

A recent investigation made on 230 conventional and jet aircraft pilots in the French Air Force has provided a comprehensive picture of the incidence of toothache in flight and of its favoring factors. Over a year of observations, it was found that 6.52% of the investigated pilots suffered from toothaches in flight. Pains developed according to a rather characteristic process during the various phases of flight: (1) chronic pulpitis induces short lived, progressively appearing, throbbing type pains which appear mostly during climbs; (2) wisdom teeth, and periapical reactions on mortified teeth or improperly stopped radicular canals rather induce pains during descents; and (3) periapical granulomas become painful in cruise flights without any marked speed variations: the induction of such neuralgias is related, among other reasons, to the vibrations experienced by the pilot. Author

N71-22310# Institute of Aviation Medicine, Fuerstenfeldbruck (West Germany).

COMBINED ENVIRONMENTAL, EMOTIONAL, AND PHYSICAL ACTIVITY THERAPY: A MODERN PREVENTIVE AND RECONDITIONING PROGRAM

J. D. Meyer-Erkelenz *In* AGARD Phys. Fitness in Flying Including the Aging and Aged Aircrew Mar. 1971 14 p refs (See N71-22301 11-05)

Avail: NTIS

Physical exercise training combined with environmental-emotional and Terrain-Kur effects is an optimal therapy in preventing and reconditioning treatment of civilization and hypokinetic diseases, because a predominantly neuro-vegetative alteration in the whole body takes place. The results on heart, respiration, muscles, vascular, metabolic, hormonal, CNS and other organic systems are detailed. The physical fitness of German Air Force pilots is maintained or increased by (1) exercise training designed for individual performance; and (2) the active cure-treatment with multiple additional therapeutic elements, e.g. sauna, hydrotherapy, skin brush massage, etc. The gymnastic exercises are described and illustrated. Positive success is demonstrated in measurable facts and stress tests before, during and after the 4 weeks of cure. Author

N71-22311# Canadian Armed Forces Inst. of Environmental Medicine, Toronto (Ontario).

AEROBIC CAPACITY SURVEY: CANADIAN FORCES PERSONNEL

C. L. Allen *In* AGARD Phys. Fitness in Flying Including the Aging and Aged Aircrew Mar. 1971 4 p refs (See N71-22301 11-05)

Avail: NTIS

The maximum oxygen intake of a representative sample of 1004 Canadian Forces personnel has been determined. The daily activity patterns as well as heights, weights, skinfold thicknesses and smoking histories were also recorded. The values for aerobic power are similar to those reported for other N.American groups in the same age range. The levels of daily activities and smoking histories have measurable effects on the endurance fitness of these personnel. Author

N71-22312# Erlangen-Nuremberg Univ. (West Germany).

FUNDAMENTAL SUBJECTS OF GERONTOLOGY AND PARTICULARITIES OF GERIATRICS

R. Schubert *In* AGARD Phys. Fitness in Flying Including the Aging and Aged Aircrew Mar. 1971 4 p (See N71-22301 11-05)

Avail: NTIS

The biological aspects of senescence are considered. For the purpose of performing systematic work in this field, it is necessary to differentiate and clearly define the various forms of calendar based or chronological senescence. Besides this form of senescence governed by the unbiased time factor, there is also the most important form of biological senescence, including the two sub-forms of physiological and psychological aging. The psychological chronograph records the personal time of an individual, the decisive factor being the experiences the individual has lived through during that period. Physiological senescence is determined by the development, growing and aging of morphae and the functions of organs. The most rigorous criteria are imposed by calendar time, which sets absolutely unbiological upper and lower age limits. The problem of flexible age limits is once more becoming most important. Author

N71-22313# Institute of Aviation Medicine, Fuerstenfeldbruck (West Germany).

PHYSICAL ACTIVITY AND AGING

H. W. Kirchhoff *In* AGARD Phys. Fitness in Flying Including the Aging and Aged Aircrew Mar. 1971 5 p (See N71-22301 11-05)

Avail: NTIS

There appears to be acceptable evidence that exercise does affect biochemical and physiological parameters related to ischemic heart disease and to the myocardium itself. It is remarkable that a physical fitness program of the German Institute of Aviation Medicine had an extraordinarily good effect on blood pressure, ECG and other parameters. Since this program was begun, increases in blood pressure have been considerably less frequent. There occurred a lowering of the heart rate at rest and during exercise, an improvement of orthostatic tolerance, normalisation of exercise induced hypoxic electrocardiographic changes at low oxygen pressure and an increase of oxygen uptake respiratory volume and oxygen pulse during physical effort. These data corroborate the concept of a preventive and rehabilitative value in physical and environmental-emotional conditioning programs. The training program provides objective evidence for a clearly favorable influence of conditioning periods on cardio-vascular function of the aging pilot. Author

N71-22314# Naval Aerospace Medical Inst., Pensacola, Fla. Naval Aerospace Medical Research Lab.

THE THOUSAND AVIATORS: A THIRTY YEAR FOLLOW UP

R. E. Mitchell, A. Graybiel, A. Oberman (Ala. Univ.), and W. R. Harlan (Ala. Univ.) *In* AGARD Phys. Fitness in Flying Including the Aging and Aged Aircrew Mar. 1971 5 p (See N71-22301 11-05)

Avail: NTIS

The thousand aviator project is a longitudinal study with the emphasis primarily on defining new physical standards for aviators and secondarily on an epidemiological study of aging. The present report is limited to a discussion of the electrocardiographic and blood pressure findings. Longitudinal changes in the resting electrocardiograms have shown that those individuals with a decrease in QRS amplitude and a leftward movement of the QRS vector appear to have a tendency to develop coronary artery disease. Some of the men in the group have shown a consistent rise in blood pressure, apparently related to weight gain and parental longevity. Otherwise there are no means by which the blood pressure pattern of an aging individual can be predicted. Author

N71-22315# Canadian Armed Forces Inst. of Environmental Medicine, Toronto (Ontario).

MORBIDITY OF AIRCREW IN THE CANADIAN FORCES IN RELATION TO AGE

W. J. C. Stevenson *In* AGARD Phys. Fitness in Flying Including the Aging and Aged Aircrew Mar. 1971 8 p (See N71-22301 11-05)

Avail: NTIS

One of the factors in the consideration of the aging process in aircrews is the relationship of illness, injury, and physiological incidents. Evaluations of 268 pilots and air navigators, representing 6.8% of the established Canadian aircrew strength, were carried out because individuals either failed to meet prescribed medical standards or else had developed some difficult, obscure or border-line medical problems which raised a question of fitness to continue flying. Data indicate that diseases of the circulatory system were cause for removal from flying duties of the largest number of older aircrew members, while psychiatric disorders resulted in the greatest number of groundings in the younger group. Author

N71-22316# School of Aerospace Medicine, Brooks AFB, Tex.

THE EFFECTS OF AGING ON BODY COMPOSITION AND EXERCISE PERFORMANCE IN THE USAF AIRCREW POPULATION

John W. Ord and Malcolm C. Lancaster *In* AGARD Phys. Fitness in Flying Including the Aging and Aged Aircrew Mar. 1971 10 p refs (See N71-22301 11-05)

Avail: NTIS

Nine hundred seventeen healthy aircrewmen ranging in age from 25 to 49 years were evaluated for minor medical findings. During the same period, 348 pilots were evaluated as part of the selection process for special projects such as space flight. The differences between the groups, and in subgroups according to age, in parameters bearing on physical fitness are described. The special project group was more fit than the other normal group, as demonstrated by their response to maximal treadmill testing, had a lesser body fat fraction and lower blood lipid and glucose levels. Older subgroups demonstrated lower maximal treadmill exercise performance, had higher body fat fractions and tended to demonstrate higher levels of blood lipids and glucose. Author

N71-22317# School of Aerospace Medicine, Brooks AFB, Tex.

A COMPARISON OF THE EFFECTS OF EARLY CARDIOVASCULAR DISEASE AND AGING UPON MAXIMAL EXERCISE PERFORMANCE IN THE USAF AIRCREW POPULATION

Malcolm C. Lancaster and John W. Ord *In* AGARD Phys. Fitness in Flying Including the Aging and Aged Aircrew Mar. 1971 8 p refs (See N71-22301 11-05)

Avail: NTIS

The influence of early, mild cardiovascular disease upon maximal exercise performance in 544 flyers, ages 40-49 years was considered. There were 300 normal subjects, 64 subjects with non-specific repolarization changes on the electrocardiogram, 114 subjects with hypertension and 66 subjects with coronary heart diseases. The NSTWC and hypertensive groups had significantly higher body fats than normals. There were no significant differences between the disease groups and normals with respect to blood sugar and serum lipids. Both the hypertensive and CHD groups had significantly lower maximal oxygen consumptions and total treadmill times than normals. Systolic blood pressures in all disease groups were significantly higher at rest than in normals. Systolic blood pressure increased as expected in normals and a parallel increase was seen in the disease groups. Diastolic blood pressure was unchanged at maximal exercise in normals, while all disease groups were significantly higher. Blood pressure levels in the hypertensive group were significantly higher at rest than the other disease groups and remained proportionately higher with exercise. Author

N71-22318# Centre Principal d'Expertises Medicales du Personnel Navigant, Paris (France).

TRACING OF ARTERIOSCLEROSIS DURING EVALUATION OF FLYING PERSONNEL [DEPISTAGE DE L'ATHEROSCLEROSE DANS L'EXPERTISE DU PERSONNEL NAVIGANT]

R. Carre, J. Salvagniac, and F. Plas *In* AGARD Phys. Fitness in Flying Including the Aging and Aged Aircrew Mar. 1971 9 p refs In FRENCH (See N71-22301 11-05)
Avail: NTIS

Cardiovascular abnormalities in more than 3000 flying personnel were studied during a 12 year period by performing electrocardiographic, cholesterol content, and carotidogrammetric evaluations. It was established that more than 30% of the disabled group had cardiovascular diseases with the greatest number found between 45 to 50 years of age; aging personnel were more accident prone and pilots of the French Air Force were grounded if they showed typical arteriosclerotic symptoms. Also grounded were pilots over 40 years of age with ECK abnormalities. Transl. by G.G.

N71-22319# Institute of Aviation Medicine, Fuerstenfeldbruck (West Germany).

PSYCHOPHYSIOLOGICAL PROCESSES OF AGING

H. J. Grunhofer and K. Gerbert *In* AGARD Phys. Fitness in Flying Including the Aging and Aged Aircrew Mar. 1971 7 p refs (See N71-22301 11-05)
Avail: NTIS

Facts observed so far concerning variations and decrement of cognitive, psychomotoric and retentive abilities with increasing age are reported. Generally it can be assumed that almost all psychophysical performance functions decrease as of the third decade of life. But abilities with increasing age are essentially dependent upon the level of original aptitude, type and extent of experience gained in the course of life, thinking patterns, and trained procedures consolidated through exercise. On the other hand, particular decreasing capabilities can only be compensated by others within certain limits. As a result, adjustment and readjustment to requirements which cannot be met by means of confirmed behavior became increasingly difficult. An analysis of presently used methods to measure flying proficiency in aging pilots is given. Author

N71-22320# Institute of Aviation Medicine, Fuerstenfeldbruck (West Germany).

HEARING ACUITY IN RELATION TO AGE AND FLYING TIME

G. R. Froehlich *In* AGARD Phys. Fitness in Flying Including the Aging and Aged Aircrew Mar. 1971 8 p (See N71-22301 11-05)
Avail: NTIS

The pure tone audiograms of 1024 Air Force pilots and 100 applicants were classified into 3 categories: (Q1) the 25% with best hearing capacity; (Q2) the 50% with medium hearing capacity; (Q3) the 25% with poorest hearing capacity; and S: hearing losses of industry population. The evaluation had the following results: (1) pilots classified as Q 1 and Q 2 had a hearing acuity that was slightly better or equal to comparative age groups of a normal industry population; (2) Even in the Q 3 groups with marked hearing losses, the main speech frequencies of 500 - 2000 Hz showed only negligible impairment; (3) the hearing acuity of jet-pilots is slightly better than that of pilots in helicopters and propeller aircraft; and (4) for the decrease in hearing acuity age is more important than flying time. Author

N71-22321# Centre de Medecine Aeronautique, Brussels (Belgium).

LONGITUDINAL STUDY OF SPIROMETER VALUES FOR NAVIGATOR PERSONNEL OF THE BELGIAN AIR FORCE [ETUDE LONGITUDINALE DES VALEURS SPIROMETRIQUES DU PERSONNEL NAVIGANT DE LA FORCE AERIENNE BELGE]

J. Bande *In* AGARD Phys. Fitness in Flying including the Aging and Aged Aircrew Mar. 1971 7 p (See N71-22301 11-05)
Avail: NTIS

Long term spirometric measurements on Belgian Air Force flying personnel, obtained over a period from 5 to 10 years, are evaluated in order to establish the influence of aging on physical fitness concurrent with the process of aging. A new special formula is presented that is applicable for ages 15 through 55 and can be used to predict the developing vital capacity for each individual subject during aging. Transl. by G.G.

N71-22341# Air Force Academy, Colo.

THE EFFECTS OF SOUND ON COLOR INTENSITY PERCEPTION

L. Ralph Chason and William P. Mockovak Dec. 1970 23 p refs
(AD-717715; USAFA-TR-70-6) Avail: NTIS CSCL 6/16

Sensory interaction occurs when the response elicited by a sense modality due to a specific stimulus is significantly affected by the simultaneous stimulation of that sensory system by any other sense modality in the body. This experiment is concerned with the interaction of audition and vision where the auditory conditions consist of no sound, pleasant sound, and unpleasant sound (as judged by the subject), and the visual conditions consist of equal intensity judgments on red, green and blue lights against a white standard. The data from thirty subjects are discussed including main effects and interaction of experimental conditions. The hypotheses concerning the differential sensitivity of the dark-adapted eye to red, green and blue colored lights are confirmed. The hypotheses concerning the influence of audition on vision are not confirmed. The potential influence of the reticular activating system is discussed in light of these findings. Author (GRA)

N71-22448# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Civil Engineering.

THE USE OF FOAM IN THE EMERGENCY SUPPORT OF HOVERCRAFT DURING POWER FAILURE AT SEA Final Report

Thomas E. Stelson Aug. 1970 33 p refs
(Contract Nonr-760(29))
(AD-717676) Avail: NTIS CSCL 6/7

The purpose of the study is to determine the effectiveness of high expansion liquid foams as a shock absorber and stabilizer

when used in the plenum chambers of hovercraft at sea and under power failure conditions. The study was conducted in two phases. Phase One was concerned with the question of stabilization of and foam flow out from under a small simple model representing a hovercraft. Briefly these tests showed that for selected values of bubble size and expansion factor, and thus viscosity, the escape of foam from the plenum chamber was at a much slower rate than the escape of air. Phase Two studies were conducted on a larger scale model to determine the response of a hovercraft to the action of waves, as if at sea, with high expansion foam filling the plenum chamber. Reduced accelerations using foam rather than air were not generally significant. The results are also difficult to extend to prototype behavior since modeling relationships for the foams are unknown. Author (GRA)

N71-22452# Aerospace Medical Div. Aeromedical Research Lab. (6571st), Holloman AFB, N.Mex.

DEPARTMENT OF TRANSPORTATION DAISY TRACK BABOON LETHAL TOLERANCE TESTS Final Report

Thomas D. Clarke Jun. 1970 179 p refs

Avail: NTIS

Comparative investigations were conducted to assess the biodynamic aspects and the protection from impact trauma provided by the lap belt, lap belt plus air bag and air bag only restraint systems. The objectives were to determine a lethal tolerance (LD sub 50) by exposure to abrupt linear deceleration (minus G sub x) and to define the patterns of injuries. Twenty-nine deceleration tests were performed with 19 adult male baboons weighting in excess of 45 lbs. Tolerance to impact (LD sub 50) was determined by sequential testing. Each baboon was impacted at a 3 g increment below or above the deceleration of the previous test, respectively depending upon whether there was or was not a fatality within three hours on the previous test. The primary advantage of this method was the concentration of testing near the tolerance level thus increasing the accuracy of LD sub 50 estimation. The LD sub 50 was that level where impact fatalities were expected in 50% of the animals. Author

N71-22513*# AiResearch Mfg. Co., Los Angeles, Calif.

PRELIMINARY DESIGN AND DEVELOPMENT OF THE INTERMEDIATE WATER RECOVERY SYSTEM, VOLUME 1 Combined Final Reports, Sep. 1969 – Dec. 1970

J. Rousseau, ed. 12 Mar. 1971 560 p Revised

(Contracts NAS9-8460; NAS9-9981)

(NASA-CR-114960; Rept-70-7018-Vol-1-Rev-1) Avail: NTIS CSCL 06B

The water recovery system comprises a number of functions concerned with the collection, processing, and storage of urine, wash water, and humidity condensate produced by a 3-man crew on board an earth orbital spacecraft. Mission duration is one year with a 90-day resupply period. The two processing units are identical and are designed to process water at the same nominal rate of 1 lb/hr. The product potable water can be stored or transferred to the spacecraft water supply. Interconnecting lines permit water transfer from one unit to the other and also provide backup capability in emergency. All waste products from the processing units are stored in the form of a concentrated brine for return to earth at the 90-day resupply period. Author

N71-22514*# AiResearch Mfg. Co., Los Angeles, Calif.

PRELIMINARY DESIGN AND DEVELOPMENT OF THE INTERMEDIATE WATER RECOVERY SYSTEM, VOLUME 2 Combined Final Report, Sep. 1969 – Dec. 1970

J. Rousseau, ed. 12 Mar. 1971 280 p Revised

(Contracts NAS9-8460; NAS9-9981)

(NASA-CR-114961; Rept-70-7018-Vol-2-Rev-1) Avail: NTIS CSCL 06B

Preliminary component specifications and performance prediction computer program description for the water recovery system are presented. Author

N71-22571*# Stanford Research Inst., Menlo Park, Calif.

TACTILE PERCEPTION STUDIES RELATED TO TELEOPERATOR SYSTEMS

J. C. Bliss, J. W. Hill, and B. M. Wilber Washington NASA Apr. 1971 79 p refs

(Contract NAS2-5409)

(NASA-CR-1775) Avail: NTIS CSCL 05E

The results of several experiments are reported dealing with tactile information processes, the use of tactile feedback in the performance of remote manipulations (teleoperator) tasks, and the development of a new software system designed for on-line experiment control by a small computer. Results of experiments designed to measure the short-term memory characteristics of visual and tactile perception suggest that short-term memory resides in an area common to both visual and tactile modalities. Results of remote manipulations studies with bilateral manipulators indicate that tactile feedback provides improved performance particularly for remote control situations where visual feedback is either poor or absent. Recommendations for improving system performance are provided. Author

N71-22664*# Systems Technology, Inc., Hawthorne, Calif.

EXPERIMENTAL VALIDATION AND ANALYTICAL ELABORATION FOR MODELS OF THE PILOT'S NEUROMUSCULAR SUBSYSTEM IN TRACKING TASKS

R. E. Magdaleno and D. T. McRuer Washington NASA Apr. 1971 93 p refs

(Contract NAS2-4828)

(NASA-CR-1757) Avail: NTIS CSCL 05E

The purpose of the experiments was to obtain direct describing function data for the muscle/manipulator actuation element, G sub m, portion of the whole human, Y sub p, in tracking situations. Both these describing functions were measured in a single-loop compensatory situation where the pilot used either a rudder pedal or a hand manipulator and controlled a first-order subcritical task for a variety of instability values. In addition second- and third-order subcritical tasks (hand manipulator only) were run to investigate neuromuscular system effects when the pilot must generate low-frequency lead. G sub m for rudder pedals and hand manipulator was quite similar in form and close in bandwidth. A spinal level closed-loop neuromuscular system was obtained which gives an excellent fit to the data if the alpha command signal is the command input to the neuromuscular system. The feedback path assumptions imply that muscle spindles are the dominant element for stiff spring restraints although the Golgi tendon organs fulfill a similar role. In addition the joint angle sensors may modify the pilot's dynamics for free-moving manipulators. For the hand manipulator, G sub m was basically unchanged for first-, second-, and third-order subcritical tasks; where the pilot must generate none, first-, and second-order low-frequency lead respectively, indicating that this lead is generated centrally rather than involving the peripheral neuromuscular system. Author

N71-22668 Purdue Univ., Lafayette, Ind.

EFFECTS OF HETEROGENEOUS TARGET BACKGROUNDS ON PHOTOGRAMMETRIC COORDINATE MEASUREMENTS

Robert Ellis Roger (Ph.D. Thesis) 1969 223 p

Avail: Univ. Microfilms: HC $10.15/Microfilm $3.00 Order No. 70-8960

This investigation is concerned with the centering by the human visual system of a black circular measuring mark in sharp circular targets simulating artificially marked points in a photographic emulsion. The results confirm that the visual system is remarkably

sensitive to tasks of this type, pointing standard deviations of the order of 0.5 seconds of arc having been obtained. The targets were viewed against an infinite density surround with complete white annular rings serving as heterogeneous symmetric background configurations. Segments of these rings were used to simulate nonsymmetric configurations. The results indicate that for tasks of this type where the target and measuring mark are well-defined, there is no significant difference between monocular and binocular viewing, except for comfort with binocular viewing being preferred. The results also show that the precision of centering in the horizontal retinal meridian is significantly greater than in the vertical meridian. Dissert. Abstr.

N71-22679*# General Electric Co., Philadelphia, Pa.
ASTRONAUT ZERO GRAVITY PERFORMANCE EVALUATION PROGRAM: DETAILED TECHNICAL REPORT
D. G. Norman, G. Miller, M. C. Grohman, and R. W. Jones Washington NASA Mar. 1971 399 p refs
(Contract NAS9-8640)
(NASA-CR-1725) Avail: NTIS HC$6.00/MF$0.95 CSCL 05E

The Astronaut Zero Gravity Performance Evaluation Program was designed to fill a gap in our knowledge of man's capabilities to perform complex tasks in the zero-gravity environment. The resultant experimental program involved an evaluation of the major facets of astronaut performance while restricted to a limited work-site area. The program was performed during the period July 1968 through February 1970 and encompassed: (1) the definition and preliminary design of Experiment M508, an experiment concerned with astronaut worksite performance evaluation; (2) the fabrication of prototype hardware and collection of simulated astronaut worksite performance data using various ground based zero-gravity simulation modes; (3) the collection of additional data on man's force emission capability to establish 1-g and zero-g baselines; and (4) the preparation and publication of a handbook of human engineering design data for reduced gravity conditions. Author

N71-22748* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
RESCUE LITTER FLOATATION ASSEMBLY Patent
Richard A. Pollard and Glenn A. Shewmake, inventors (to NASA) Issued 26 Sep. 1967 (Filed 24 Aug. 1965) 8 p Cl. 9-312
(NASA-Case-XMS-04170; US-Patent-3,343,189;
US-Patent-Appl-SN-482311) Avail: US Patent Office CSCL 06B

A rescue device consisting of a Stokes-type litter which has flotation equipment at the head end and an inflatable tube at the foot end is described. When used for water rescue operations, the litter floats vertically with the head end up. The person to be rescued is fastened to the litter while in the vertical position. The inflatable tube at the foot end is then inflated to cause the litter to assume a horizontal position which permits easier lifting of the person from the water. P.N.F.

N71-22896* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
DIGITAL CARDIOTACHOMETER SYSTEM Patent
Virden M. Mitchell, inventor (to NASA) Issued 21 May 1968 (Filed 1 Oct. 1965) 5 p Cl. 128-2.06
(NASA-Case-XMS-02399; US-Patent-3,384,075;
US-Patent-Appl-SN-492344) Avail: US Patent Office CSCL 06B

A system is devised for measuring the heartbeat rate over a predetermined portion of a minute. A pulse representative of a heartbeat is used to reset a counting circuit, each time the counting circuit is reset pulses are fed to a memory network. The number of counts stored on the memory network are fed into a readout circuit where the heartbeat rate in beats per minute is displayed. Thus, if the heartbeat is pressured over a fifteen second interval, four pulses will be fed to the memory for each heartbeat pulse signal, and if the heartbeat is measured over a ten second interval, six pulses will be fed to the timing circuit for each heartbeat pulse signal. A diagram of the proposed system is included. Official Gazette of the U.S. Patent Office

N71-23053 Advisory Group for Aerospace Research and Development, Paris (France).
PRINCIPLES AND PRACTICE OF BIONICS
H. E. von Gierke, W. D. Keidel, and H. L. Oestreicher, eds. Oct. 1970 481 p refs Presented at the Bionics Symp., Belgium, 18–20 Sep. 1968
(AGARD-CP-44) Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

Bionic principles, techniques, and processes are applied to the study of living and life-like systems that find application in man-made technology. The support which biology and medicine lend to engineering processes is emphasized. For individual titles see: N71-23054 through N71-23079.

N71-23054 Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
BIONICS AND BIOENGINEERING IN AEROSPACE RESEARCH
Henning E. von Gierke *In* AGARD Principles and Pract. of Bionics 1968 p 21–41 refs (See N71-23053 11-05)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The life sciences, physical sciences, mathematical sciences and engineering have developed important interdisciplinary areas of common interest and cross fertilization. These areas, characterized according to their goal by terms such as bionics, cybernetics, biophysics and bioengineering, have particularly been fostered in connection with such rapidly developing technologies as required by the challenges of advances in aerospace flight. These interdisciplinary areas are outlined and their present and future goals and some of the practical results, potential pay-offs and promises are discussed. Author

N71-23055 Stanford Univ., Calif. Dept. of Electrical Engineering.
ON MODELLING THE NERVOUS SYSTEM
M. A. Arbib *In* AGARD Principles and Pract. of Bionics 1968 p 43–57 refs (See N71-23053 11-05)
(Grant AF-AFOSR-1198-67)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

An overview of the functions of a cybernetic brain is given and the notion of neuroheuristic programming is introduced. Discussed are various modes of distributed information processing pertinent to modeling neuropsychological experiments. Various motives for modelling the nervous system and a consideration of their implications are given. Author

N71-23059*# California Univ., Los Angeles. Space Biology Lab.
LEARNING FROM THE BIOLOGICAL VIEWPOINT
W. P. Adey *In* AGARD Principles and Pract. of Bionics 1968 p 99–118 refs (See N71-23053 11-05)
(Contracts NsG-237-62; NsG-502, NsG-505; NsG-1970; AF 49(638)-1387 et al)
(NASA-CR-117806) Copyright. Avail: NTIS; Technivision, Braywick House, Maidenhead, Berks, Engl. US Distribution: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido) CSCL 06D

Neurophysiological studies have indicated adaptive patterns in central nervous tissue, that relate in finely correlated ways with

past experiences in cerebral systems. There is a hierarchy of observations from EEG records in performing man to cellular and subcellular phenomena that constitute substrates of gross processes, such as the EEG. These findings have suggested structural and functional schemes in cerebral tissue that relate to its unique capacity in storage, as opposed to transaction, of information; and to memory as a plastic tissue change, in contrast to the mere fixation of experience. Author

N71-23060*# Adaptronics, Inc., McLean, Va.
ADAPTIVE FLIGHT CONTROL SYSTEMS
Roger L. Barron *In* AGARD Principles and Pract. of Bionics 1968 p 119–167 refs Sponsored by NASA, AF and Navy (See N71-23053 11-05)
(NASA-CR-117807) Copyright. Avail: NTIS; Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido) CSCL 06D

The bionics approach is contributing to development of a new generation of adaptive flight controls. These controls organize themselves in their problem environment by use of a guided parameter space search. It has been found that the probability state variable (PSV) search algorithm is well suited for flight control, particularly for coupled, multi-variable systems. The PSV algorithm has its expression in multiple correlation logic units which identify time varying functional relationships between the plant excitation and response vectors. Continuous on-line performance assessment processes are used to guide the search. The performance assessment criterion can embody conflicting requirements imposed by the need for error minimization along with conservation of control resources. Controller networks consisting of performance assessment modules, correlation logic modules, and summing devices provide a path between each error input and each actuator excitation signal. Self-organizing systems achieve simultaneous control of plant multiple response variables. Results of several applications studies are described to demonstrate validity and potential of the approach. Author

N71-23065 Laboratoire de Physiologie Acoustique, Jouy-en-Josas (France).
REVIEW OF THEMES PERTAINING TO BIOLOGICAL AND BIONIC ECHOLOCATION [THEMES DE REFLEXIONS A PROPOS DE L'ECHOLOCATION BIOLOGIQUE ET DE LA BIONIQUE]
R. G. Busnel *In* AGARD Principles and Pract. of Bionics 1968 p 231–237 refs In FRENCH; ENGLISH summary (See N71-23053 11-05)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

Echolocation is pre-eminently one of the best themes of cooperation between biologists and engineers; it is typically bionic. It is shown by means of a few examples taken out of discussions on bats' and dolphins' sonars, that there are some points of agreement and some divergences, sometimes deep, between adherents of both disciplines. Author

N71-23066 Syracuse Univ., N.Y. Lab. of Sensory Communication.
VIBROTACTILE INFORMATION TRANSFER
Jozef J. Zwislocki *In* AGARD Principles and Pract. of Bionics 1968 p 239–259 refs Sponsored in part by Natl. Inst. of Neurological Diseases and Blindness (See N71-23053 11-05)
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The skin covering human and animal bodies is endowed with several sensory systems which provide information about the environment in the immediate vicinity of the body. Some of the receptors respond to mechanical deformations of the body surface. Because the mechano-receptive systems appear to be relatively fast, attempts have been made to use them in artificial communication systems. A discussion of similarities and differences between the auditory and tactile characteristics is presented. The point of view is taken that if a set of transformations could be found such that the pertinent auditory characteristics could be mapped onto tactile characteristics, tactile speech communication in real time and with an extensive vocabulary becomes possible. It is pointed out that two tactile systems with strikingly different characteristics respond to vibration. Conditions under which one or the other system is activated are discussed. Author

N71-23067 Sheffield Univ., (England). Dept. of Psychology.
COMPUTER SIMULATION OF SOME VISUAL FUNCTIONS
Neville Moray *In* AGARD Principles and Pract. of Bionics 1968 p 261–274 refs (See N71-23067 11-05)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

Simulations of lateral inhibitory networks were carried out, keeping as closely as possible to the values of the biological constants known from physiological work. The aim was to see whether such networks will produce figural aftereffects. Aftereffects were found, but the model was not quantitatively successful. A discussion of such networks shows that they provide a rapid dark and light adaptation mechanism, a brightness range compressor and an image enhancer. Author

N71-23068 University Coll., London (England). Dept. of Electrical Engineering.
NEURONAL MODELS OF PATTERN RECOGNITION, LEARNING AND SIZE INVARIANCE MECHANISMS IN THE BRAIN
W. K. Taylor *In* AGARD Principles and Pract. of Bionics 1968 p 275–291 refs (See N71-23053 11-05)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The integration of mathematically defined model neurons and synapses into functional learning networks is described. The networks form a complete functional system representing retina, visual cortex, association areas and mid-brain feedback paths. Properties of a synthesized model include learning to read alphanumeric characters, handwritten words, and the recognition of complex random patterns and human faces. Size invariance is also a feature of the model and it is shown that the postulated mathematical transformations lead to generalizations between size and distance whereby an object seen only at one distance in the past is recognized without further learning at any new distance. Furthermore, the new distances are predicted without clues from accommodation or binocular fusion. It is shown that the transformations can produce visual illusion signals when the receptive field contains conflicting information. Author

N71-23070 IIT Research Inst., Chicago, Ill. Odor Sciences and Olfactronics Center.
OLFACTORY INFORMATION PROCESSING AND MECHANISMS
Andrew Dravnieks *In* AGARD Principles and Pract. of Bionics 1968 p 309–340 refs (See N71-23070 11-05)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

Vapors from various sources contain information about a source's nature and state. Living organisms interpret these chemical signals by means of receptor systems that can be either highly specialized

and sensitive, as in some insects, or be able to interpret many complex chemical signals. Much signal processing occurs at the receptor level. The systems discriminate signals in terms of a limited number of dimensions, less than ten, having complex physicochemical correlates. The receptor mechanism involves intermolecular interactions of odorant molecules with the receptor membranes and probably utilizes sensor or discriminatory substances. Coding at the higher neural level utilizes stimulation, no effect or inhibition. A review of physicochemical analytical processes indicates that olfactory analogs based on low resolution processes utilizing intermolecular interactions and the internal chemical logic of the source in principle can match human olfaction in sensitivity, speed and information content, and exceed it in accuracy. Author

N71-23071 Technische Univ., Berlin (West Germany).
BIOTECHNIQUE OF OSCILLATING PROPULSION SYSTEMS AND THEIR INTEGRATION INTO THE BODY
H. Hertel *In* AGARD Principles and Pract. of Bionics 1968 p 341–369 (See N71-23053 11-05)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

An experimental investigation on biological oscillating propulsion systems has been carried out using fishes and water-channel models. Biomechanical considerations led to five new solutions, which have undergone investigation as models: (1) plate propeller for ship propulsion in shallow water and for towing; (2) plate propeller for pumping sludge; (3) engine arrangement behind fuselage for making use of the energy accumulated in the boundary layer (external integration); (4) development of low-drag fuselage-shapes; and (5) underfloor installation of propulsion units in the fuselage of VTOL aircraft. Author

N71-23072 Glasgow Univ. (Scotland). Dept. of Electrical Engineering.
METHOD FOR THE ANALYSIS OF THE NEURAL MECHANISMS FOR POSTURAL ADJUSTMENTS
T.D.M Roberts and D. J. Murray-Smith *In* AGARD Principles and Pract. of Bionics 1968 p 371–407 refs (See N71-23053 11-05)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The laws of signal transformation by which the central nervous system constructs patterns of motor command from streams of sensory impulses are discussed. The pattern of motor commands to a limb extensor muscle in the cat in reflex response to rhythmic stretch is matched by computer simulation using a technique of parameter sensitivity testing. The response alters during head tilting and the parameters of the model are adjusted to maintain the match. The required laws of signal transformation are those that predict the nature of the necessary parameter changes from the time course of the labyrinthine signal reporting the head tilt. Author

N71-23074 Michigan Univ., Ann Arbor.
MECHANISMS OF BIOLOGICAL MEMORY
R. J. von Baumgarten *In* AGARD Principles and Pract. of Bionics 1968 p 411–423 refs (See N71-23053 11-05)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The evolution of biological memory as a process of adaption to the environment proceeded in gradual stages. The neurophysiological mechanisms of learning and memory are not known yet. The connectivity hypothesis of memory assumes that synaptic connections between neurons could change their efficacy, allowing new functional connections to be made. This hypothesis is challenged by the possibility of extra synaptic storage sites. Experiments with Aplysia neurons show that they can recognize, store and reproduce time intervals between stimulations. Conditioning at the cellular level would take place by the capability of special nerve cells to re-excite themselves after a subthreshold stimulus is given, but only if this stimulus was paired during a training period with a stronger threshold-reaching stimulus. The latency of this reself-excitation corresponds roughly to the interstimulus interval. Author

N71-23076 Wildfowl Trust, Slimbridge (England).
ASPECTS OF BIRD NAVIGATION
G. V. T. Matthews *In* AGARD Principles and Pract. of Bionics 1968 p 447–455 refs (See N71-23053)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The nature and extent of migratory and homing flights and the conditions in which birds are able to navigate are described. Time compensated compass orientation is shown with reference to the sun and moon. The alignment of constellations is also used to obtain directional information. Bi-coordinate navigation is based on the discrimination of sensory stimuli. These do not appear to be based on the Earth's magnetic field or rotational effects, but on interpretation of the sun's position and movement along its arc. The sensory requirements and the degree to which they are met in the bird's physiology are discussed. Author

N71-23078 Illinois Univ., Urbana.
BIONICS: CRITIQUE AND OUTLOOK
H. von Foerster *In* AGARD Principles and Pract. of Bionics 1968 p 467–473 refs (See N71-23053 11-05)
(Contracts AF 33(615)-3890; AF-AFOSR-7-68; Grant OEC-1-7-071213-4557)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

A critical assessment of bionics and its interdiciplines is given. The central problem of information processing is the reduction and compression of information bionically by statistical analysis. G.G.

N71-23080* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
GAS PURGED DRY BOX GLOVE Patent
Gustav Reinhardt, Max Quatinetz, and Thomas P. Herbell, inventors (to NASA) Issued 22 Aug. 1967 (Filed 12 Jan. 1965) 4 p Cl. 312-1
(NASA-Case-XLE-02531; US-Patent-3,337,279; US-Patent-Appl-SN-425096) Avail: US Patent Office CSCL 06Q

A gas purged dry box glove is described which is particularly adapted for use in dry box operation involving material sensitive to air or moisture such as submicron metal powders, also poisonous and radioactive materials. The dry glove box comprises an inner glove and an outer glove. The inner glove is adapted to sealingly engage the wrist of the wearer. The space between the inner and outer gloves is maintained at a pressure slightly higher than atmospheric by an inert gas admitted near the hand enclosing portion and exhausted near the hand receiving end. The inner and outer gloves are sealed and joined at the hand receiving end. Thus, the permeation of air or moisture into a dry box or isolator is reduced by diffusion of moisture through the gloves. E.M.C.

N71-23096* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
SOFT FRAME ADJUSTABLE EYEGLASSES Patent
Robert O. McBrayer, inventor (to NASA) Issued 23 Apr. 1968 (Filed 6 Jul. 1966) 3 p Cl. 2-14

(NASA-Case-XMS-06064; US-Patent-3,378,851; US-Patent-Appl-SN-563646) Avail: US Patent Office CSCL 06B

A pliable frame for sunglasses is described suitable for folding and packaging in emergency survival kits. The frames are constructed from a laminate of nylon and Velcro. The glasses are held in place by two elastic bands which extend from the sides of the sunglass frame around the wearer's head and are secured by Velcro tabs. Official Gazette of the U.S. Patent Office

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N71-21856 Colorado Univ., Boulder.
ADSORPTION ON LIQUID-COATED ADSORBENTS
Yoshihiro Takahashi (Ph.D. Thesis) 1969 138 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 70-5896

An investigation was conducted in order to clarify the elution mechanisms in gas-liquid chromatography. Static sorption isotherms were determined for acetone, n-hexane, and some other solutes on several liquid-coated diatomaceous earth supports and porous glass beads. The isotherms were determined gravimetrically with a fused quartz microbalance and a vacuum system which furnished solute relative pressures of 0.001 to 0.1 Using a simple additive relationship between the total amount sorbed and the amount present in each phase, a method to obtain more accurate activity coefficients at infinite dilution from sorption isotherms was proposed. The method was shown to give satisfactory agreement with true activity coefficients calculated from solubility data. The adsorptive properties of firebrick was also studied in terms of heats and entropies of adsorption. Dissert. Abstr.

N71-21945 Massachusetts Univ., Amherst.
SOME ASPECTS OF THE ORGANOMETALLIC CHEMISTRY OF TITANIUM, ZIRCONIUM, HAFNIUM AND NICKEL
Henry Bratton Gordon (Ph.D. Thesis) 1969 209 p
Avail: Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 70-6673

The action of n-butyllithium on hexachlorobenzene in etheral solvents produces pentachlorophenyllithium in good yield. This reagent has been characterized by the formation of a variety of pentachlorophenyl derivatives of metals and metalloids as well as organic derivatives. Pentachlorophenyllithium was found to exhibit moderate stability in solution, especially ethyl ether at −10 deg to 0 deg. The formation of pentachlorophenyllithium in this manner represents an example of a halogen-lithium interconversion reaction involving a benzenoid aromatic chloride. Pentachlorophenyllithium in ethyl ether has been applied to the synthesis of sigma-bonded pentachlorophenyl derivatives of nickel and titanium. Trends in the proton NMR spectra of these sigma-bonded organonickel complexes are discussed. An estimate of the relative thermal stability and the products of thermal decomposition of these organonickel complexes has been made possible through the application of mass spectrometric thermal analysis. Dissert. Abstr.

N71-22061# Joint Publications Research Service, Washington, D.C.
COLORIMETRIC OXIDATION REDUCTION REACTIONS IN ANALYZING THE AIR OF INDUSTRIAL ENTERPRISES
I. A. Lyamin *In its* Atmospheric Studies at Chem. Enterprises 9 Mar. 1971 p 81−101 refs (See N71-22055 11-13)
Avail: NTIS

Reduction oxidation reactions used for colorimetric analysis of atmospheric toxic impurities of chemical processing plants are assessed. Tables summarize data on the physico-chemical properties of toxic reducing and oxidizing agents, electron transfer and chemical reactions, and redox reactions for analyzing toxic reducing and oxidizing agents. E.C.

N71-22062# Joint Publications Research Service, Washington, D.C.
KINETIC METHODS OF ANALYZING ORGANIC COMPOUNDS
A. A. Druzhinin *In its* Atmospheric Studies at Chem. Enterprises 9 Mar. 1971 p 102−118 refs (See N71-22055 11-13)
Avail: NTIS

Kinetic methods for analyzing organic compounds using catalytic reactions are surveyed. Catalysis by reversible redox systems, semireversible redox systems, and by principal valence is discussed. It is concluded that kinetic analyses allow highly accurate determination of the maximum permissible concentration of harmful industrial agents. E.C.

N71-22073 Ohio State Univ., Columbus.
DETERMINATION OF THE COMPLEXITY CONSTANTS OF TRANSITION METAL HALIDES AND POLYPHOSPHATES
James Frederick Reed (Ph.D. Thesis) 1969 210 p
Avail: Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 70-6861

In determining the stability constants of various metal complexes, three different methods were used. Two, which were based on spectrophotometry, included Bjerrum's method of corresponding solutions and the slope-intercept method. The third involved a mathematical solution from a series of mass-balance equations and potentiometric titrations of metal polyphosphates with acid using the glass pH electrode. Dissert. Abstr.

N71-22103 California Univ., Berkeley.
METALLOCARBORANE STRUCTURE INVESTIGATION BY SINGLE-CRYSTAL X-RAY ANALYSIS
David John St. Clair (Ph.D. Thesis) 1969 138 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 70-6209

The solid state structures of two four carbon metallocarboranes were determined by analysis of the X-ray diffraction patterns from single crystals of carboranes of nickel, chromium, cesium, and cobalt. Correlations between these structures and those of other metallocarboranes are made. Metallocarboranes are qualitatively compared concerning the possibility of free rotation of the Ligands. Dissert. Abstr.

N71-22142# Naval Postgraduate School, Monterey, Calif.
A STUDY OF PASSIVITY OF IRON IN NONAQUEOUS SOLUTION
Stephen Marks Burkhalter (M.S. Thesis) Jun. 1970 65 p refs (AD-717495) Avail: NTIS CSCL 11/6

Passivity in aqueous solutions is reviewed and several proposed passivity models are outlined. Passivity in the non-aqueous solution of acetic acid-acetic anhydride was observed and characterized by voltage measurements. These measurements show a striking similarity to those in aqueous solution. This suggests that the same basic process is involved in both cases. Sulfuric acid, nitric acid, and chromium trioxide were used as passivating agents in the non-aqueous medium and their order is the same as in aqueous solution. The difference in the actual species in solution raises the question of the applicability of several of the passivity models outlined. Finally, suggestions are made for experiments to clarify the passivation process using non-aqueous passivated specimens. Author (GRA)

N71-22171# Avco-Everett Research Lab., Everett, Mass.
VIBRATIONAL RELAXATION OF CO BY Fe-ATOMS
C. W. von Rosenberg, Jr. and Kurt L. Wray Dec. 1970 21 p refs Sponsored in part by DASA

(Contract F19628-70-C-0144)
(AD-717742; AERL-RR-345) Avail: NTIS CSCL 7/4

Shock tube investigations on Fe(CO)5 + Ar mixtures are described. Behind incident shocks we observe immediate decomposition of the iron pentacarbonyl to yield Fe and vibrationally cold CO; the CO is then very efficiently relaxed by the Fe-atoms. The results are interpreted to yield a relaxation time for CO infinitely dilute in Fe at 1 atm of P(tau)(CO, Fe) of about 0.06 atm micro sec for T = 1400-2900K. This is believed to be the first measurement of vibrational relaxation by metal atoms. Author (GRA)

N71-22225# Princeton Univ., N.J. Dept. of Aerospace and Mechanical Sciences.
WAVE PROPAGATION IN NEMATIC LIQUID CRYSTALS
Ahmed C. Eringen and James D. Lee Sep. 1970 32 p refs
(Contract N00014-67-A-0151-0004)
(AD-717396; TR-17) Avail: NTIS CSCL 7/4

Basic laws of motion of micropolar continuum are presented, and the adequacy of applying micropolar theory to liquid crystals is indicated. A set of constitutive equations are derived for nematic liquid crystals. Wave propagation problems are solved, and it is shown that the theoretical analysis is in good agreement with the experimental data, which indicates the isotropy of the phase velocity of the longitudinal wave and the anisotropy of the damping coefficient. The coupling, although small, is shown to exist between longitudinal and rotational waves. Author (GRA)

N71-22249# Hawaii Univ., Honolulu. Dept. of Physics and Astronomy.
STUDY OF SCATTERING AND FLUORESCENCE OF GASES IN THE VACUUM ULTRAVIOLET Final Report, 1 Apr. 1965 - 30 Sep. 1970
Frederick M. Matsunaga, Kenichi Wantanabe, and William Pong 30 Oct. 1970 103 p refs
(Contract AF 19(628)-4967)
(AD-717771; AFCRL-70-0615) Avail: NTIS CSCL 7/4

Measurements of spectral absorption and photoionization cross sections of O2, NH3, O2, COS, NO, N2, and vinyl chloride in the region 5801650 A were made. A number of new Rydberg series were found and the convergence limits were compared with the photoionization values. In the study of dispersed fluorescence from molecules, particular attention was given to the emissions from CO, NH3, N2, and NO in the spectral region 1800 to 6000 A. The experimental Franck-Condon factors for CO and N2 were found to be in good agreement with the theoretical values. The excitation spectra of NO show many overlapping states. The excitation spectra of other molecules such as H2, O2, and SO2 were studied, and certain features of the emission spectra can be related to the spectral absorption. The effect of molecular collisions on the fluorescence of NO was investigated. Author (GRA)

N71-22256# Northeastern Univ., Boston, Mass. Dept. of Chemistry.
STUDY OF THE ADSORPTION OF INSOLUBLE AND SPARINGLY SOLUBLE VAPORS AT THE GAS LIQUID INTERFACE OF WATER BY GAS CHROMATOGRAPHY
Barry L. Karger, Peter A. Sewell, Reynaldo C. Castells, and Arleigh Hartkopf 15 Jan. 1971 38 p refs
(Contract N00014-68-A-0207-0002)
(AD-717735; TR-2) Avail: NTIS CSCL 7/4

The paper is a continuation of the study of the interfacial properties of water by gas chromatography. Adsorption characteristics at zero surface coverage of a large number of solutes at the gas-liquid interface of water are presented. In all cases of relatively nonpolar solutes; the differential heat of adsorption is found to be less than the heat of liquefaction, indicating the gas liquid interface of water as a low energy surface. For n-propyl ether the heat of adsorption is 4 kcal/mole higher than the heat of liquefaction, strongly suggesting hydrogen bond formation between the ethereal oxygen and the hydrogens from the water surface of the liquid. Also studied was the infinitely dilute solubility characteristics of several non-electrolytes in the thin layers of water coated on wide pore diameter adsorbents. From layer thickness of about 30 A up to 2000 A, the solubility remains constant. Finally some preliminary adsorption and sorption isotherms, determined by gas chromatography, are presented. Author (GRA)

N71-22292# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Trauen (West Germany). Abteilung Treibstoffchemie und Treibstofftechnik.
SUPPLEMENTAL EXPERIMENTS FOR THE PREPARATION OF OZONE DIFLUORIDE [ERGAENZENDE UNTERSUCHUNGEN ZUR DARSTELLUNG VON O3F2]
Klaus Meier and Dieter Genthe May 1970 42 p refs In GERMAN; ENGLISH summary
(DLR-FB-70-55) Avail: NTIS; ZLDI Munich: 11.50 DM

The preparation of ozone difluoride in an electrical discharge under several operating conditions, i.e. the shape of the reactor, the influence of the electrodes, and their mode of operation are discussed explicitly. The observations and experiences made are illustrated. Author (ESRO)

N71-22421# Chicago Univ., Ill. James Frank Inst.
DYNAMICS OF CHEMICAL REACTIONS. 1: DYNAMICS OF FLUORINE ATOM REACTIONS. 2: INTERMOLECULAR POTENTIALS FROM HIGH RESOLUTION DIFFERENTIAL CROSS SECTIONS. 3: COLLISION INDUCED DISSOCIATIONS OF DIATOMIC MOLECULES Technical Progress Report, 1 Apr. - 31 Dec. 1970
Yuan Tseh Lee 1970 8 p refs
(Contract AT(11-1)-2092)
(COO-2092-1) Avail: NTIS

Progress is reported for the three chemical reaction dynamics programs under investigation. Project related papers are listed, including seminar and conference papers. E.C.

N71-22439# Electrotechnical Lab., Tokyo (Japan).
A SURVEY ON THE ELECTRICAL CONDUCTION OF POLYMERS
Sumio Hirota Nov. 1969 105 p refs In JAPANESE; ENGLISH summary *Its* Circulars of the Electrotech. Lab. No. 166
Avail: NTIS

A systematic arrangement of concepts on the mechanism of electrical conduction, of some experimental methods, and of distinctions expected between ionic and electronic conduction are given. The dependences of the electrical conduction on the duration of applied voltage, on the intensity of electric field, on the temperature, and on the intensity of hydrostatic pressure are discussed. The effects of molecular structure, morphological properties, and impurities in polymers, are also dealt with. Data on the relations between electrical conduction and other physical properties of polymers, such as diffusion constant, viscosity, and dielectric constant, are compiled. Ideas and methods that are devoted to deciding the nature of charge carrier and the magnitude of the mobility of charge carrier are shown. Some results obtained on special problems of the electrical conduction of polymers: (1) electrical conduction in thin polymer films; (2) effects of ionizing radiation and photoelectric effects; and (3) current oscillations, are discussed. Photoelectric effects and current oscillations are treated in some detail. The polymers which are dealt with in this review are those that contain no fillers such as carbon black, silika, and pigments. Electrical properties of semiconducting polymers and polymer solutions are referenced in some cases. Author

N71-22447# Oak Ridge National Lab., Tenn.
[ANALYTICAL RESEARCH AND DEVELOPMENT, SERVICE

ANALYSES, AND SUPPORT ACTIVITIES] Annual Progress Report, Period Ending 30 Sep. 1970
W. S. Lyon, ed. Jan. 1971 82 p refs
(Contract W-7405-eng-26)
(ORNL-4636) Avail: NTIS

Instrumentation research and development and computer analytical systems are discussed, along with transmission and scanning electron microscopy, electron spectroscopy, X-ray diffraction studies, and electron microprobe analysis. Activities were carried out in three areas: LMFBR reactor fuel analysis, the transuranium program, and MSRE fuel analyses. For quantitative results from the spark source mass spectrometer used for impurity analyses, relative sensitivity factors were established for rare earths and certain actinides. Isotopic determinations are also reviewed. Analytical methodology, reactor projects, nuclear and radiochemical, and analytic biochemical investigations are briefly summarized. J.A.M.

N71-22558*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Propulsion Div.
OIL ABSORBING POLYMERS
H. E. Marsh, Jr. *In its* JPL Quarterly Tech. Rev., Vol. 1, No. 1 Apr. 1971 p 49–56 refs (See N71-22551 11-30)
Copyright. Avail: NTIS HC$6.00/MF$0.95 CSCL 07D

Elastomeric cross-linked polymers absorb large amounts of compatible solvents, and yet remain solid. Two goals are being considered: one goal is a material that can be used as a dietary additive which will selectively absorb fats and oils in the digestive tract and hold them until elimination, thus preventing their assimilation. The other goal is a material that can be used in oil slick mop-up operations. Presented are the interim results on the formulation and testing of three polymer types. Performances amounting to oleic acid absorption of up to 20 times the dry polymer weight have been measured. Higher values are expected. Both mineral oil and a cooking oil are also absorbed, but to a smaller extent. Author

N71-22572 Washington Univ., Seattle.
THE POTENTIAL ENERGY OF INTERACTION OF CHEMICALLY SATURATED MOLECULES AND GOLD SURFACES
David Jacob Lando (Ph.D. Thesis) 1969 167 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 70-8421

The physical adsorption isotherms of argon and oxygen at liquid nitrogen temperatures, and of neopentane, tetramethylsilane, diethylether, and methanol at 0 C and 19 C on a vacuum evaporated gold film were determined by means of a quartz microbalance. The potential energy of interaction of a chemically saturated molecule and a gold surface is found to be proportional to the inverse square of the molecule to metal distance, and to the molecular polarizability of the molecule, and is different than predicted by all of the existing theories. The interaction energy was determined at molecule to metal distances from 20 to 180 A. The design and construction of an adsorption apparatus utilizing a quartz crystal microbalance with a mass sensitivity on the order of 10 to the minus 8th power gm/sq cm is discussed in detail. The observed frequency changes are corrected for the effect of hydrostatic pressure and aerodynamic loading. Dissert. Abstr.

N71-22643 Essex Univ., Colchester (England).
THE STUDY OF CHEMICAL REACTIONS BY QUADRUPOLE MASS SPECTROMETRY
J. N. Bradley, W. D. Capey, J. R. Gilbert, and A. J. Park *In* AGARD New Exptl. Tech. in Propulsion and Energetics Res. Oct. 1970 p 383–394 refs (See N71-22626 11-12)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The operating principles of a quadrupole mass spectrometer are described briefly. Some modifications which were made to a commercial instrument to enlarge its usefulness for kinetic studies are also listed. The use of the apparatus in three applications is described: flash photolytic reactions, heterogeneous reactions, and unstable intermediate detection. Author

N71-22644 Gas Council, London (England).
MASS SPECTROMETRIC AND OTHER TECHNIQUES FOR INVESTIGATION OF THE CATALYTIC DECOMPOSITION OF HYDRAZINE ON PLATINUM AT LOW PRESSURE
E. M. A. Willhoft and A. J. B. Robertson (London Univ.) *In* AGARD New Exptl. Tech. in Propulsion and Energetics Res. Oct. 1970 p 395–400 refs (See N71-22626 11-12)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Eng. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

Mass spectrometry of atoms, free radicals, and transient intermediates evaporating from a heated catalytic surface in the presence of a reactant gas at low pressure are discussed. Advantages of the quadrupole spectrometer are considered. The decomposition of hydrazine at a pressure of 0.00002 torr on heated platinum gives diimide, which was observed with a quadrupole mass spectrometer. Other features of the reaction under various conditions are described, particularly the amounts of stable products formed, and the probability of reaction of a hydrazine molecule at a single collision with the platinum surface. Author

N71-22669 University of Southern Calif., Los Angeles.
MECHANISTIC STUDY OF AIR POLLUTION
Terry Eugene Ernest (Ph.D. Thesis) 1969 106 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 70-8522

A theoretical mechanism has been formulated in an attempt to model the reactions involved in the production of air pollution. This mechanism was tested against data obtained in chamber experiments of an irradiated system containing nitric oxide, nitrogen dioxide, and propylene. The average error of prediction of this mechanism as compared to experimental data is 10%. This error is well within the uncertainty of the experimental data which has an average error of 20%. This mechanism clearly indicates that the photochemical reaction in this system requires the presence of free radical chain reactions. The relative concentrations of certain free radicals were shown to have only small effects on the concentration vs. time curves of the products and the reactants. However, the lack of any one of these free radicals in the system severely affected the predicted results. Dissert. Abstr.

N71-22670 Tennessee Univ., Knoxville.
LOW TEMPERATURE MASS SPECTROMETRY OF FLUORINE CONTAINING COMPOUNDS
Stephen Samuel Cristy (Ph.D. Thesis) 1969 130 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 70-7555

A cryogenic reactor-inlet system for use with the Hitachi Perkin–Elmer RMU-6E mass spectrometer has been designed and constructed for the study of very reactive fluorine-containing compounds and species which are stable only at subambient temperatures. Liquid nitrogen is the usual coolant. A 50 ohm resistance wire heater is used to control the sample temperature from minus 196 deg to ambient temperatures. The mass spectra of sulfur hexafluoride, chlorine trifluoride, and tetrafluorohydrazine, obtained using this apparatus were compared with previously reported spectra and found to be satisfactory. Because of the reduced inlet temperatures, the higher mass fragments were found to be of more importance than in the reported spectra. Mass spectra of chlorine monofluoride and nitrosyl fluoride were also obtained. Chemical synthesis in this apparatus using pyrolysis, photolysis, and microwave discharge was demonstrated. Dissert. Abstr.

N71-22717# National Bureau of Standards, Boulder, Colo. Cryogenics Div.
SURVEY OF CURRENT INFORMATION ON LNG AND METHANE AND MEASUREMENTS OF THE THERMOPHYSICAL PROPERTIES OF COMPRESSED FLUID METHANE Annual Progress Report
1 Feb. 1971 91 p refs Sponsored by Am. Gas Assoc., Inc.
(NBS-9781; APR-1; U-204) Avail: Issuing Activity

Research reported includes: (1) a brief summary of the results of a literature survey on liquefied natural gas and methane; (2) a report on the Second International Conference on Liquefied Natural Gas; and (3) a description and summary of studies on the thermophysical properties of compressed fluid methane. Two published research papers on the thermophysical properties studies are presented, along with a manuscript on the preliminary computation of thermodynamic properties of methane. D.L.G.

N71-22975* Federal-Mogul Corp., Los Alamitos, Calif. Arrowhead Products Div.
HYDRAULIC CASTING OF LIQUID POLYMERS Patent
Robert B. Trelease, inventor (to NASA) Issued 7 May 1968 (Filed 12 May 1966) 5 p Cl. 18-26 Continuation-in-part of US Patent Appl. SN-220982, filed 4 Sep. 1962 Sponsored by NASA
(NASA-Case-XNP-07659; US-Patent-3,381,339; US-Patent-Appl-SN-567806) Avail: US Patent Office CSCL 07D

Improvements are described to an apparatus for casting materials, such as liquified polymers, under elevated pressures. In a pressurized, closed-mold system, a cord member is provided which includes channeled and outwardly tapered or conical ends adapted to be mated or received in conical supporting surfaces within the cavity of the mold. These surfaces are arranged adjacent to opposed transfer and exit fluid conducting ports. The channels of the conical end portions are uniformly distributed and extend radially from the apex to form sprues terminating about the circumference of the end portions of a cylindrical body of the core so that as viscous material is fed or forced from a first isolating valve into the mold cavity, through the sprues, it is injected from one end of the cavity in a uniform manner. The injected material progresses along the exerior surface of the body of the core to be discharged from the cavity to a second isolating valve, through the converging channels or sprues of the opposite end. The isolating valves at either side of the cavity isolate the mold to assure that desired pressure and material distribution is maintained within the mold during the injection and curing stages of the casting process.
Official Gazette of the U.S. Patent Office

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N71-21854# Oak Ridge National Lab., Tenn.
EFFECTS OF NUCLEAR EMP ON AM RADIO BROADCAST STATIONS IN THE EMERGENCY BROADCAST SYSTEM
D. B. Nelson Jan. 1971 81 p refs Sponsored in part by Office of Civil Defense and AEC
(AD-717319; ORNL-TM-2830; OCD-PS-64-284) Avail: NTIS CSCL 17/2

The study included interviews with station personnel and other efforts to identify typical station construction and practice, as well as analytical treatments of the transients induced by EMP on station antennas and power line. Most likely sources of damage are determined and the possibility and time requirements of effecting repairs are estimated. Station experience with lightning and a comparison of direct lightning strokes to the antenna with the EMP caused surges are included. Recommendations are given for measures which may reduce EMP damage or the extent of its effects. In most cases these are limited to procedures or low cost improvements. Conservative overdesign to achieve very high reliability is not currently recommended for stations participating in the EBS. Author (GRA)

N71-21855 Pennsylvania Univ., Philadelphia.
A STUDY OF MULTIPLE ACCESS COMMUNICATION SYSTEM
Edmond Yu-shang Ho (Ph.D. Thesis) 1969 89 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 70-7807

A digital communication system to be used among low-flying aircraft which, individually, require the transmission channel infrequently is analyzed. To make more efficient use of the transmission medium without the need for intervening switching centers, a form of random access is planned. Transmission is largely along line-of-sight; multipath propagation is assumed to be involved. Dissert. Abstr.

N71-21876# Radio Technical Commission for Aeronautics, Washington, D.C.
MINIMUM PERFORMANCE STANDARDS, EMERGENCY LOCATOR TRANSMITTERS SURVIVAL TYPE, ELT(S) OPERATING ON 121.5 AND 243.0 MEGAHERTZ
5 Nov. 1970 27 p Supersedes Paper 26-59/DO-94
(DO-146) Avail: NTIS; RTCA Secretariat, Suite 655, 1717 H St., N.W., Washington, D.C. 20006: $8.00

Minimum performance standards for survival type emergency locator transmitters are presented. Compliance with these standards by manufacture and users is recommended as a means of assuring that the equipment will satisfactorily perform its intended function under all conditions normally encountered in search and rescue operations. Author

N71-21877# Radio Technical Commission for Aeronautics, Washington, D.C.
MINIMUM PERFORMANCE STANDARDS, EMERGENCY LOCATOR TRANSMITTERS: AUTOMATIC FIXED, AUTOMATIC PORTABLE, AND AUTOMATIC DEPLOYABLE TYPE OPERATING ON 121.5 AND 243.0 MEGAHERTZ
5 Nov. 1970 32 p
(DO-147) Avail: NTIS; RTCA Secretariat, Suite 655, 1717 H St., N.W., Washington, D.C. 20006: $8.00

Minimum performance standards for automatic fixed, automatic portable, and automatic deployable type emergency locator transmitters are presented. Compliance with these standards by manufacturers and users is recommended as a means of assuring that the equipment will perform its intended function under all conditions normally encountered in search and rescue operations. Author

N71-21910# System Development Corp., Santa Monica, Calif.
INTRODUCTION AND OVERVIEW OF THE VICENS REDDY SPEECH RECOGNITION SYSTEM Technical Memorandum
Iris Kameny and H. Ritea 4 Dec. 1970 7 p refs
(Contract DAHC15-67-C-0149; ARPA Order 1327)
(AD-717624; SDC-TM-4652/001/00) Avail: NTIS CSCL 17/2

The Vicens-Reddy system is unique in the sense that it approaches the problem of speech recognition as a whole, rather than treating particular aspects of the problem as in previous attempts. For example, where earlier systems treated only segmentation of speech into phoneme groups, or detected phonemes in a given context, the Vicens-Reddy system processes the incoming

speech signal, applies heuristics to segment the signal and to identify phoneme-like units and then uses the total phonemic pattern to recognize an entry in the lexicon. The Vicens-Reddy system divided into six parts: (1) hardware preprocessing, (2) software preprocessing, (3) segmentation, (4) recognition, (5) lexicon development, and (6) lexicon usage. Author (GRA)

N71-21923# Naval Postgraduate School, Monterey, Calif.
VISUAL DETECTION OF MICROWAVE FIELD PATTERNS USING LIQUID CRYSTALS
Hosseih Torkan (M.S. Thesis) Sep. 1970 65 p refs
(AD-717583) Avail: NTIS CSCL 20/14

Although point by point electric field mapping has been known for many years using point detectors, the method is laborious, time consuming, and produces errors due to the probe disturbances of the actual field and some information may be lost by discrete scanning of the field. The paper represents the results of a theoretical and experimental investigation to use a liquid crystal area detector of the microwave field, where continuous color displays the field intensities of an open-ended waveguide, a parabolic antenna focus and the interference pattern of the field between a source and a reflector. Experimental confirmation of certain phases of the microwave field theory is included. Author (GRA)

N71-21998 Missouri Univ., Columbia.
EDGE STRUCTURE AND THE REPRESENTATION OF PICTURES
James Dougal Campbell (Ph.D. Thesis) 1969 111 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 70-6566

Various methods for representing pictures in digital form are presented. Some specific properties of the human visual system are used to design a reduced bandwidth digital picture transmission scheme in which the received pictures are free of the standard quantization noise. The system incorporates two dimensional digital filters which precede and follow the system quantizer. A method for obtaining the inverse of a restricted class of filters is described. Results of a computer simulation of the system are presented. An edge detection algorithm and a contour tracing algorithm are described. Their use is discussed within the framework of an automated medical diagnosis scheme based on X-rays. Test results of applying the algorithms to two radiographs are presented. Finally, the image scanning system is described. Included is a discussion of a noise removal system for the scanning camera, a uniform light source for film illumination, and an analysis of various display methods for photographing output pictures. Dissert. Abstr.

N71-21999 Ohio State Univ., Columbus.
APPLICATION OF SPATIAL DIVERSITY TO ATMOSPHERIC OPTICAL LINE-OF-SIGHT COMMUNICATION SYSTEMS
Thomas Allen Brackey (Ph.D. Thesis) 1969 179 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 70-6732

An experimental program to obtain and process data from a dual channel two kilometer path link with an array of two transmitting laser sources aimed (through the turbulent atmosphere) at a single lens receiver was undertaken. The received fading signal levels were recorded and processed using an off line digital computer to check the fading statistics of carrier signal levels on individual channels and to determine: (1) The correlation between fades on adjacent channels as a function of spatial separation between channels at the transmitter and (2) The dual-channel diversity improvement resulting from optimal-selection switching and equal weight combining diversity signal processing. Experimentally derived system parameters were also used to calculate the diversity improvement for equal weight combining for systems composed of more than two channels. Dissert. Abstr.

N71-22000 Ohio State Univ., Columbus.
AN INVESTIGATION OF TIME DIVISION MULTIPLE ACCESS SPACE COMMUNICATIONS SYSTEMS
Ronald J. Huff (Ph.D. Thesis) 1969 215 p
Avail: Univ. Microfilms: HC $9.70/Microfilm $3.00 Order No. 70-6803

A class of time division multiple access (TDMA) space communications systems was developed in which (1) system synchronization is provided by sampled data delay lock loops and (2) data signalling is implemented using the differential phase shift keying (DPSK) signalling technique. A description of the alternative system configurations is given and appropriate analyses performed. The results provide a complete bases for the design of TDMA systems belonging to the class investigated. Dissert. Abstr.

N71-22121# Philco-Ford Corp., Palo Alto, Calif.
FREQUENCY SELECTIVE SURFACE SUBREFLECTOR DEVELOPMENT REPORT, 29 JANUARY 1969 – 30 MAY 1970
Gary H. Schennum 2 Nov. 1970 80 p refs Prepared for Lincoln Lab., MIT, Lexington
(Contract AF 19(628)-5167)
(AD-717780; ESD-TR-70-418) Avail: NTIS CSCL 17/9

The need, in microwave tracking and radar systems for antennas with a dual-frequency capability, has necessitated the development of multi-frequency, multipurpose antennas. It is the purpose of the report to describe one type of dual-frequency antenna that has been made operational. In particular, this antenna is the M.I.T. - Millstone Hill antenna. Author (GRA)

N71-22132# Naval Postgraduate School, Monterey, Calif.
THE APPLICATION OF CONVOLUTIONAL CODES TO THE HIGH FREQUENCY CHANNEL
James Brayton McCrumb (M.S. Thesis) Sep. 1970 99 p refs
(AD-717599) Avail: NTIS CSCL 9/4

The HF channel is characterized with regard to frequency selective fading and atmospheric noise under restrictive mathematical assumptions, and compared with measured statistics. Actual channel characteristics are utilized to obtain parameters for choosing appropriate convolutional codes. Short threshold decodable convolutional codes with only a moderate amount of interleaving are shown to be capable of affecting a reduction in the output error probability by at least an order of magnitude, for uncoded error probabilities on the order of 0.02. Author (GRA)

N71-22148# New Hampshire Univ., Durham. Antenna Systems Lab.
AN INTERFEROMETER SYSTEM FOR THE MEASUREMENT OF THE AZIMUTH OF RADAR ECHOES FROM METEOR TRAILS
Ronald R. Rudman, Filson H. Glanz, Albert D. Frost, and Ronald R. Clark 15 Aug. 1970 62 p refs
(Contract F19628-67-C-0230)
(AD-717776; ASL-70-1; AFCRL-70-0588; SR-1) Avail: NTIS CSCL 4/1

To improve the measurement of the azimuth direction of arrival of radar echoes at 36.8 MHz, a digitally controlled phase sequence interferometer technique has been developed for incorporation into the UNH/AFCRL meteor trails radar system. Phase measurements are made with respect to a common calibration pulse inserted between successive echoes. Preliminary tests indicate an azimuth measurement capability of better than plus or minus 2 degrees when used in conjuction with an elevation measurement system of comparable accuracy. Author (GRA)

N71-22211# Joint Publications Research Service, Washington, D.C.
TELEMETRY DEVICES FOR RECORDING BOUNDARY

LAYER FLOW CONDITIONS DURING LOCOMOTION IN A WATER AMBIENT

L. F. Kozlov et al *In its* Hydrodyn. Probl. of Bionics 12 Mar. 1971 p 68–76 refs (See N71-22201 11-05)
Avail: NTIS

Telemetry equipment for determining flow conditions in the boundary layer of autonomous self-propelled models and individual aquatic animals, such as dolphins and tuna, is discussed. The equipment consists of a wire thermoanemometer, transmitter, information transmission channel, receiver, and recording device. The equipment has been designed for the transmission of information by cable and radio frequency channel. The cable equipment is highly reliable and offers simplicity of information transmission when taking measurements in restricted bodies of water such as in a pool or pen. In large bodies of water this type of device can be used only on subjects strong enough to tow the cable. Radio telemetry equipment can be small in size and light in weight, and the effective range is superior to equipment using hydroacoustic communications channels due to rapid attenuation of ultrasonic signals in water and negative effects of ultrasonic waves on physiological and locomotive functions of aquatic animals. A.L.

N71-22233# Boeing Scientific Research Labs., Seattle, Wash. Mathematical and Information Sciences Lab.

SCATTERING FROM LAYERED TARGETS. 1: FORMULAS FOR THE SCATTERING COEFFICIENTS FOR A MULTILAYERED SPHERE

T. A. Bray and T. P. Higgins Dec. 1970 14 p refs *Its* Mathematical and Inform. Sci. Lab. No. 40
(AD-717642; D1-82-1015) Avail: NTIS CSCL 17/9

The layering of targets provides a means of enhancing or decreasing the radar cross-section over a resonance region which can be centered at a desired frequency and increased in extent by suitable practical adjustments of material constants. When one is calculating results in the resonance region all of the quantities of interest, which include the angular scattering and absorption, are obtained by summing generalized Mie series which contain the scattering coefficients. In this note a simple formulation for these coefficients is given for a composite sphere composed of any number of homogeneous but otherwise arbitrary concentric spheres. Author (GRA)

N71-22250# North Carolina State Univ., Raleigh.

PSCYHOACOUSTIC ASSESSMENT OF SPEECH COMMUNICATION SYSTEMS: THE DIAGNOSTIC DISCRIMINATION TEST

Craig Blaine Grether 22 Sep. 1970 120 p refs
(Contract F44620-69-C-0033)
(AD-717789; AFOSR-70-2939TR) Avail: NTIS CSCL 17/2

The report traces the rationale, development and experimental evaluation of the Diagnostic Discrimination Test (DDT). The DDT is a three-choice test of consonant discriminability. Specifically, it is a test of the discriminability of the perceptual/acoustic dimensions of consonant phonemes within specific vowel contexts. The DDT was created and developed in an attempt to provide a diagnostic assessment of communication system deficiencies to aid in system design and development. Results are presented in terms of the sensitivity of the DDT to various degrees of speech impoverishment, and of the reliability of the DDT upon successive experimental replications. Author (GRA)

N71-22251# Ohio State Univ., Columbus. Electroscience Lab.

THE INVERSE SCATTERING AND TARGET IDENTIFICATION PROBLEM

K. J. Breeding and A. A. Ksienski 4 Nov. 1970 73 p refs
(Contract AF-AFOSR-1710-69)
(AD-717747; ESL-2768-4; AFOSR-70-2780TR) Avail: NTIS CSCL 17/9

In order to obtain an exact solution to the inverse scattering problem, the target response is required over a continuous band of frequencies and aspect angles. An alternative approach to the problem which requires a much more modest amount of measurement data but assumes substantial a priori information is as follows: A finite set of alternatives is specified regarding target shape and composition and a set of measurements is carried out to provide the answer as to which one of the alternatives holds. Since it is necessary to restrict the measurements to a relatively small range of frequencies the question arises as to what frequency band is best to characterize the target and to provide the most reliable discrimination from other targets. The best apparent choice is the highest frequency possible since for a given percent bandwidth it would contribute the greatest amount of information. However, an examination of the Fourier transform of the impulse response indicated that the frequency range corresponding to wavelengths starting with the size of the object and increasing to ten times its dimension would provide the most useful initial information. It is low frequency range which is used in this paper to characterize the various objects of interest, and provides the information used to identify the objects. Author (GRA)

N71-22289# Office of Research Analyses, Holloman AFB, N.Mex.

FUNDAMENTAL LIMITATIONS IN TRACING THE ORIGINS OF TECHNOLOGY Final Report

Ernest J. Davis Jun. 1970 76 p refs
(AD-717701; ORA-70-0022) Avail: NTIS CSCL 5/1

A simple model from statistical communication theory is used to evaluate the probability of success in tracing research results which comprise origins of technology. The model has also been used to evaluate the probability of success in tracing research and technology origins of systems. A by-product of the study is the use of the same model for evaluating the probability of success of forecasting applications of research results and of technology advances. Use of the model has permitted the conclusion that certain fundamental limitations to successful tracing and forecasting exist. These limitations are analogous to well-known physical limitations in successful electrical communication -- bandwidth and noise. Bandwidth and noise are closely related to the classification systems for the originating categories (bandwidth) and for the receiving categories (noise). Author (GRA)

N71-22322# Air Force Cambridge Research Labs., Bedford, Mass.

A TECHNIQUE FOR MEASURING PHASE AT MILLIMETER WAVELENGTHS

Frederick H. Cleveland and Nicholas P. Kernweis 20 Nov. 1970 20 p refs
(AD-717688; AFCRL-70-0693; AFCRL-PSRP-437) Avail: NTIS CSCL 14/2

A technique that utilizes a reference signal of varying phase for measuring the phase of millimeter signals in free space is described. The phase of the reference signal is measured independently and subtracted from the total phase measured to determine the desired phase. The use of a varying reference phase is necessary because flexible or movable waveguides whose phase characteristics can readily be measured are not available at millimeter wavelengths. The theory of the technique described is based upon the interference pattern of slowly varying electric fields. Author (GRA)

N71-22324# Air Force Cambridge Research Labs., Bedford, Mass.

FORWARD AND BACK SCATTER CHARACTERISTICS OF SPHERICALLY SYMMETRIC OVERDENSE CLOUDS FOR SEVERAL ELECTRON DENSITY DISTRIBUTIONS

Milton M. Klein 23 Nov. 1970 21 p refs
(AD-717685; AFCRL-70-0686; AFCRL-ERP-340) Avail: NTIS CSCL 20/14

Knowledge and understanding of the propagation of electromagnetic waves through the ionosphere, ionspheric irregularities, and artificial electron clouds, provide the information and criteria needed to solve Air Force problems of discrimination, detection, and communication. Because the electron density distribution changes during expansion of a cloud, it is desirable to know how the change affects the scattering characteristics of the cloud. A determination, in geometric optics approximation, of the forward and backscatter characteristics of spherical overdense clouds having: (1) a gaussian decrease with distance from the center, (2) a sech squared, or exponential, decay, and (3) an inverse-squared decrease, showed that the back scatter cross section for the inverse square distribution is always larger than for the other two distributions. As the center point density increases, the back scatter cross section obtained with the gaussian sphere most rapidly takes on the characteristics of a conducting sphere, that of the sech squared distribution lags slightly behind, but that of the inverse-square sphere never gets close to the result for a conducting sphere. In forward scatter, the inverse-square distribution shows the largest cross section and a fairly rapid increase with center point density, the sech squared distribution has an essentially constant cross section, and the gaussian, which has the lowest forward scatter cross section, shows a slight decrease with center point density. Author (GRA)

N71-22325# Radio Corp. of America, Moorestown, N.J. RCA Missile and Surface Radar Div.

AN/PPS-18(XN-1) ULTRA RELIABLE RADAR Interim Development Report, 1 – 31 Dec. 1970

J. D. Frattura Jan. 1971 20 p

(Contract N00039-70-C-3502)

(AD-717672; IDR-11) Avail: NTIS CSCL 17/9

The program covers the study, design, construction, test analysis and inspection of a complete and operative, highly reliable, relative failure-free version of the pulsed doppler surveillance AN/PPS-6 radar set. The radar set is intended to be a lightweight, miniaturized, X-band, pulse doppler combat surveillance radar. The basic purpose of the program is to develop a highly reliable radar set considering the overall cost of ownership when development, production and maintenance costs are taken into account while keeping the same general performance, form-factor and weight as the AN/PPS-6 radar. Author (GRA)

N71-22346# Infoton, Inc., Burlington, Mass.

TEMPORAL WAVEFORM CLASSIFICATION USING SELECTED PATTERN RECOGNITION TECHNIQUES Final Report

Ernest G. Henrichon, Jr. 3 Nov. 1970 93 p refs

(Contract F44620-70-C-0048)

(AD-717754; AFOSR-70-2762TR; Rept-186-1) Avail: NTIS CSCL 17/1

The report describes efforts aimed toward solving a particular acoustical waveform classification problem through the application of advanced pattern recognition procedures. The problem under investigation is similar to many surveillance and reconaissance tasks which may require special processing of such media modulatable energy signals as acoustic, electro-magnetic, seismic and electrostatic. The primary concern of this investigation was the application of classification procedures, as opposed to the development of pertinent feature extraction methods. The list of classification techniques tested included the Wiener Canonical Expansion Procedure, the Exponentially Mapped Past Method and the Empirical Processing Algorithm. The results of this investigation clearly indicate that, no matter what classification approach used, the end results are limited by the information contained in the selected feature set Author (GRA)

N71-22440# Radio Technical Commission for Aeronautics, Washington, D.C.

MINIMUM PERFORMANCE STANDARDS: EMERGENCY LOCATOR TRANSMITTERS: PERSONNEL TYPE ELT(P) OPERATING ON 121.5 AND 243.0 MEGAHERTZ

5 Nov. 1970 28 p refs

(DO-145) Avail: NTIS, RTCA Secretariat, Suite 655, 1717 H Street, N.W., Washington, D.C. 20006

The minimum performance standards for personnel type emergency locator transmitters, ELT(P) are given. Compliance with these standards by manufacturers and users is recommended as a means of assuring that the equipment will satisfactorily perform its intended function under all conditions normally encountered in search and rescue operations. The measured values of radio equipment performance characteristics may be a function of the method of measurement; standard test conditions and methods of test are also recommended. Author

N71-22471*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

OPTIMIZATION OF SPACE ANTENNA STRUCTURES

Ewald Heer and Jann-Nan Yang 1 Apr. 1971 25 p refs

(Contract NAS7-100)

(NASA-CR-117854; JPL-TM-33-472) Avail: NTIS CSCL 09E

An optimization scheme was developed which can readily be applied to design of space antennas as well as to the evaluation and comparison of antenna concepts, antenna structural types, and antenna structural materials. With system requirements such as antenna gains, communication frequencies, etc., as constraints, the objective function is minimized with respect to the design variables. Through this optimization process, it is demonstrated whether the effort of improving a particular technology, such as manufacturing, has advantages under certain operational requirements. Author

N71-22562*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Engineering Mechanics Div.

LARGE SPACECRAFT ANTENNAS: NEW GEOMETRIC CONFIGURATION DESIGN CONCEPTS

R. E. Oliver *In its* JPL Quarterly Tech. Rev., Vol. 1, No. 1 Apr. 1971 p 78–85 ref (See N71-22551 11-30)

Copyright. Avail: NTIS HC$6.00/MF$0.95 CSCL 09E

Several unconventional approaches to the configurational design of high-gain microwave antenna reflectors are presented. The first class of design approaches involves relatively minor modifications of conventional dual-reflector (Cassegrain and Gregorian feed) antenna concepts. These modifications eliminate the loss of transmitted energy resulting from the reflection of energy back into the feed from the subreflector as well as the loss due to interception of rays by the subreflector after reflection from the main reflector. The second class of concepts involves the use of a conical main reflector and multiple reflections from this main reflector and from one or more subreflectors. These concepts offer the advantage of relative ease of fabrication, inspection, and furlability associated with a single curvature (conical) main reflector. In addition, they provide configurations with very small diameter subreflectors, resulting in low aperture area blockage and small furled antenna diameters. Author

N71-22563*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Telecommunications Div.

ANTENNA SUPPORT STRUCTURE APERTURE BLOCKAGE LOSS

A. Ludwig *In its* JPL Quarterly Tech. Rev., Vol. 1, No. 1, Apr. 1971 p 86–96 refs (See N71-22551 11-30)

Copyright. Avail: NTIS HC$6.00/MF$0.95 CSCL 09E

Loss in antenna gain caused by support structure aperture blockage is probably the most difficult factor to measure or calculate. In this article the loss is determined experimentally for aluminum and fiberglass structural configurations, and empirical formulas are developed to calculate the loss for other similar configurations. Experimental and analytical data on the X-band RF

transmission characteristics of thin fiberglass sheets are presented. It is concluded that fiberglass structures are far superior for minimizing gain loss. Author

N71-22564*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Telecommunications Div.

INTERPLEX MODULATION

S. Butman and V. Timor *In its* JPL Quarterly Tech. Rev., Vol. 1, No. 1 Apr. 1971 p 97–105 refs (See N71-22551 11-30)

Copyright. Avail: NTIS HC $6.00/MF $0.95 CSCL 17B

In a conventional phase-shift-keyed/phase modulated (PSK/PM) system, the receiver tracks the frequency and phase of the carrier by means of a phase-locked loop and coherently demodulates the data. However, due to the inherent nonlinearity of the phase-modulation process, some power is transmitted as cross modulation, which reduces the useful available power. Described is a new PSK/PM modulation scheme, called Interplex, which reduces the cross-modulation power loss. The scheme can be implemented in existing systems without significant hardware changes and appears attractive in concept for improving the performance of deep space telecommunications systems. Author

N71-22623*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

RESULTS AND ANALYSIS OF A COMBINED AERIAL AND GROUND ULTRAHIGH FREQUENCY NOISE SURVEY IN AN URBAN AREA

Godfrey Anzic and Charlene May Washington Apr. 1971 34 p refs

(NASA-TM-X-2244; E-6002) Avail: NTIS CSCL 17B

The results of a combined aerial and ground survey of radiofrequency noise are presented. The measurements were made at 0.3, 1.0, and 3.0 gigahertz. Simultaneous air measurements were made while conducting the ground measurements. The primary objectives of the survey were to determine the correlation between air and ground noise data and to demonstrate the ability to identify high urban noise areas from aerial data. The results of the survey indicate that identification of high urban rf noise areas can be accomplished from aerial data. Good correlation between simultaneous air and ground noise data was obtained for properly selected ground sites. Author

N71-22624*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

LONGITUDE REPOSITIONING OF HIGH POWER COMMUNICATION SATELLITES

Thomas A. O'Malley Washington Apr. 1971 31 p refs

(NASA-TM-X-2258; E-6037) Avail: NTIS CSCL 17B

An analysis of the methods and requirements for longitude repositioning of a satellite in synchronous equatorial orbit is presented. The fuel requirement for the repositioning maneuver is determined as a function of the change in longitude, the time of transit from the initial to the final longitude, and the acceleration imparted to the satellite by the propulsion system. It is shown that for low-thrust electric propulsion, continuous thrust over many orbits may be necessary to effect the required change in longitude. Author

N71-22659 New York Univ., N.Y. School of Engineering and Science.

SEQUENTIAL AND NONSEQUENTIAL DETECTION PROCEDURES BASED ON ORDER STATISTICS

Harold Brownstein (Ph.D. Thesis) 1969 126 p

Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 70-9767

Nonsequential and sequential detection procedures based on order statistics are developed. These procedures are then applied to problems in radar detection and digital communications. In the first part of the thesis, nonsequential order statistic detection procedures are discussed: the latter is defined as a procedure where the decision to reject or accept the null hypothesis is based on the value of one of the ordered samples in a decision sample of a fixed size. It is shown that this class of procedures have certain desirable properties; (1) they are easy to implement, (2) the c.d.f. of the test statistic can be analytically determined for all sample sizes in all noise environments and (3) the c.d.f. of the test statistic is asymptotically normal in all noise environments. The latter two properties imply that the performance of this test can always be analytically determined. Dissert. Abstr.

N71-22718 Purdue Univ., Lafayette, Ind.

PERFORMANCE OF COMMUNICATION SYSTEMS USING THE TURIN MULTIPATH CHANNEL MODEL

Stanley Elmer Nykanen (Ph.D. Thesis) 1969 169 p

Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 70-8935

The affects are considered of a type of multipath communication channel; the slowly varying, flat fading channel. The channel model used is that advanced by Turin. The concept of a strongly mixing random process is introduced. It is shown that when the channel impulse response satisfies the strongly mixing property, the decision variables of the receiver which maximized the aposteriori probability of correct detection possess a joint asymptotic Gaussian distribution. For the asymptotic case of a large number of paths, estimates of the probability of error performance for various realistic signal sets are obtained. The binary FSK signal set is considered along with a binary signal set consisting of a common-band up-chirp and down-chirp. It is shown that the performance of the chirp signal set approaches the performance of the ideal FSK signal set for large time-bandwidth products. Dissert. Abstr.

N71-22719 California Univ., Los Angeles.

ELECTROMAGNETIC SURFACE WAVE PROPAGATION ON YTTRIUM IRON GARNET AND INDIUM ANTIMONIDE RODS AT MICROWAVE FREQUENCIES UNDER AXIAL MAGNETIZATION

John Wilbur Tully (Ph.D. Thesis) 1969 181 p

Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 70-8215

Electromagnetic propagation on gyrotropic rods is of considerable interest because the propagation can be altered by changing the biasing magnetic field. Recently, exact theories were developed which predict new characteristics of this wave propagation. Experiments were performed which are applicable to analysis by these theories and which demonstrate the characteristics of surface wave propagation on gyrotropic rods. A gyromagnetic rod of single crystal yttrium iron garnet was investigated for its propagation characteristics. The experiments made use of the low loss properties of YIG by launching a surface wave on a rod used as a surface wave cavity resonator. The measured dispersion curves show excellent agreement with theoretical calculations. Electromagnetic propagation on gyroelectric rods was investigated on a single crystal InSb rod. Measurements of the relative phase and amplitude along the rod constituted data used for phase velocity determination. Dissert. Abstr.

N71-22750* Hughes Aircraft Co., Culver City, Calif.

LOW NOISE SINGLE APERTURE MULTIMODE MONOPULSE ANTENNA FEED SYSTEM Patent

Paul A. Jensen, inventor (to NASA) Issued 12 Mar. 1968 (Filed 2 Nov. 1964) 8 p Cl. 343-786 Sponsored by NASA

(NASA-Case-XNP-01735; US-Patent-3,373,431; US-Patent-Appl-SN-408438) Avail: US Patent Office CSCL 09C

A feed system for monopulse antennas which includes a bridge capable of providing sum and dual plane difference modes for two orthogonal polarization orientations is described. A multimode matching section is connected to match the principal modes from the bridge and to inhibit undesired modes. An excitation and control section is used to control the phases of the different modes and to excite additional modes. When these additional modes are combined with the sum modes they minimize the side lobes of the radiated sum patterns in both the E and H planes. PNF

N71-22756 Princeton Univ., N.J.
ROBUST DETECTION AND ESTIMATION
Richard Douglas Martin (Ph.D. Thesis) 1969 123 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 70-8379

It is shown that robust detection and estimation of signals of known form in nearly Gaussian noise may be obtained by incorporating a light limiter into the usual optimum parametric procedure. A two stage procedure involving the use of a light limiter is shown to be an asymptotic min-max solution to the estimation problem, and this estimator is shown to be robust in terms of efficiency. In the time continuous case, two models for nearly normal random processes are studied. These are the Gaussian mixture process and the Gaussian quasi-mixture process. It is shown that the Gaussian mixture process never satisfies the strong mixing condition, while under mild restrictions on the spectrum, the Gaussian quasi-mixture process does satisfy this condition. Using a Gaussian quasi-mixture process which satisfies a strong mixing condition, it is shown that the continuous version of the limiter-correlator is robust in terms of A.R.E. Dissert. Abstr.

N71-22757 Carnegie-Mellon Univ., Pittsburgh, Pa.
VARIATIONAL SOLUTIONS OF THE MAXWELL EQUATIONS WITH APPLICATIONS TO WAVE PROPAGATION IN INHOMOGENEOUSLY FILLED WAVEGUIDES
William Joseph English (Ph.D. Thesis) 1969 211 p
Avail: Univ. Microfilms: HC $9.70/Microfilm $3.00 Order No. 70-7328

Electromagnetic wave propagation within inhomogeneously filled waveguide structures is studied. The Maxwell equations are approximately (exactly) satisfied by means of a variational principle. Several variational principles are derived and applied to a class of waveguides inhomogeneously filled for which no closed form exact solutions are available. The solution method yields the approximate (exact) cutoff frequencies for the lower order modes, permitting a calculation of the usable bandwidth of a waveguide structure. Dissert. Abstr.

N71-22773*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
REFRACTIVITY INFLUENCE ON DSS DOPPLER DATA
F. B. Winn and R. K. Leavitt *In its* The Deep Space Network, Vol. 1 15 Feb. 1971 p 31-41 refs (See N71-22766 11-30)
Avail: NTIS CSCL 17B

Doppler data from deep space missions are examined for terrestrial media contamination. It was shown that contamination influences remain even after least square fitting. Cross correlation between solution parameters and the media induced errors is large enough to adversely affect parameter least square adjustments. When a scale factor for Cain's tropospheric refractivity profile is included in the parameter list, the media induced observed minus-computed (O - C) structures do not appear above 15 deg elevation. When the scale factor is not included, O - C structures commence to appear at approximately 25 deg elevation. Author

N71-22774*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A SECOND/THIRD ORDER HYBRID PHASE LOCKED RECEIVER FOR TRACKING DOPPLER RATES
R. C. Tausworthe *In its* The Deep Space Network, Vol. 1 15 Feb. 1971 p 42-45 refs (See N71-22766 11-30)
Avail: NTIS CSCL 17B

A stable phase locked receiver configuration for tracking frequency ramp signals is described. A usual second order receiver is used for lockup; subsequently a very simple modification is made to the loop filter, altering the loop to one of the third order. The altered loop then tracks the incoming signal with zero static phase error. The receiver bandwidth is practically unchanged; the damping factor lies in the region 0.5 and 0.707, and the design point is 12 db in gain margin above instability. Author

N71-22778*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
TRACKING AND DATA ACQUISITION ELEMENTS RESEARCH: POLARIZATION DIVERSE S BAND FEED CONE
D. E. Neff and A. J. Freiley *In its* The Deep Space Network, Vol. 1 15 Feb. 1971 p 66-72 refs (See N71-22766 11-30)
Avail: NTIS CSCL 17B

Development of the polarization diverse S band (PDS) feed cone that is used on the DSS 14 210 ft diam antenna tricone is described. The PDS system integrates the knowledge gained in two previous feed system developments and provides a highly flexible microwave front end. Right handed circular polarization, left-handed circular polarization, and orthogonal linear polarizations are available on low noise listen only or diplexed channels. Additionally, a research and development radar capability for 500 kW continuous wave power is provided. The system further provides manual or automatic servo tracking of the position angle of received linear polarization, which will be used for radio science purposes. Author

N71-22780*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ANTENNA STRUCTURES: EVALUATION OF REFLECTOR SURFACE DISTORTIONS
M. S. Katon *In its* The Deep Space Network, Vol. 1 15 Feb. 1971 p 76-80 refs (See N71-22766 11-30)
Avail: NTIS CSCL 09E

The modifications as well as the complete formulations are graphically and algebraically presented for reflector surface distortions of antennas and their effect on radio frequency performance. Data manipulations to improve the accuracy of field measurements using the angle measuring theodolite method are described. A best fitting computer program was used in the analysis. Error bounds are included. E.H.W.

N71-22781*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ANTENNA RIGGING ANGLE OPTIMIZATION WITHIN STRUCTURAL MEMBER SIZE DESIGN OPTIMIZATION
R. Levy *In its* The Deep Space Network, Vol. 1 15 Feb. 1971 p 81-87 refs (See N71-22766 11-30)
Avail: NTIS CSCL 09E

It is shown that the horizon rms deviation of the antenna from the best fitting paraboloid is a representative measure of the cosine weighted average rms for the complete elevation attitude range. The advantages of rms reduction via the choice of rigging angle are discussed. Numerical examples and parameters are included. Author

N71-22788*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMMUNICATIONS CONTROL GROUP ASSEMBLY: TELETYPE LINE SWITCHING EQUIPMENT
D. W. Passell *In its* The Deep Space Network, Vol. 1 15 Feb. 1971 p 113-116 (See N71-22766 11-30)
Avail: NTIS CSCL 17B

The teletype portion of the communications control group assembly installed in the GCF's deep space station communications equipment subsystem is described. The functions, developmental

status, and operational features of the teletype switching equipment are discussed; and the necessity for interfacing with a variety of communications common carriers is explained. Author

N71-22814# Israel Program for Scientific Translations, Ltd., Jerusalem.

RADIO COMMUNICATION CONDITIONS DURING LEVANEVSKII'S FLIGHT, 12–13 AUGUST 1937

L. P. Kuperov *In its* Probl. of the Arctic and the Antarctic 1970 p 105–114 refs (See N71-22801 11-13)

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Analysis of radio communication conditions during Levanevskii's flight was based on data of solar and magnetic activities. The principal data were daily measurements of the strength of radio signals from surface radio stations performed in Tikhaya Bay. Modern ideas concerning the effect on the earth's atmosphere of the streams of electrically charged particles emitted by active regions of the sun were also considered. Investigative interest was limited to the entry points of radio waves into the absorbing layer, since the Tikhaya Bay measurements showed that the ionization of the F2 layer was always sufficient for reflection of 17 meter radio waves. Therefore, all radio communication failures were due to absorption of radio waves. Records indicate that August 1937 was characterized by high geomagnetic activity and high intensity of ultraviolet solar radiation. Results of the analysis indicate that the flight did not terminate at 1432 hours on 13 August when the message on the failure of the right outboard engine was received, but that the flight continued until the aircraft crashed into the ice at some as yet undetermined point. These conclusions were based on two transmissions presumably from the aircraft received at two stations subsequent to this time. A.L.

N71-22848# Israel Program for Scientific Translations, Ltd., Jerusalem.

ROUND THE WORLD ECHO AND VERY FAR PROPAGATION OF SHORT RADIO WAVES

L. P. Kuperov *In its* Probl. of the Arctic and the Antarctic 1970 p 365–367 refs (See N71-22801 11-13)

Copyright. Avail: NTIS HC$6.00/MF$0.95

Analysis of the radio link established in 1930 between the northernmost radio station on Franz Josef Land and the radio station at Little America in the Antarctic showed that the conditions favoring extra long range reception on short waves was similar to those arising in round-the-world echoes. The conditions were approximately the same as twilight illuminance of the high ionized layers of the atmosphere along the entire path of radio waves passing along the sunrise and sunset boundaries. Using a map of great circles and terminator graphs a table was compiled showing local time and directions at conditions close to twilight. Data from the table may be used directly for all locations in the Northern Hemisphere between latitudes 56 and 74 deg N, or near the equator. For the Southern Hemisphere, all directions must be reversed and times altered by twelve hours. The table may also be used for determining hours and directions favoring the arrival of radio disturbances and radio station signals on the wave band near the operating frequency. A.L.

N71-22860# Israel Program for Scientific Translations, Ltd., Jerusalem.

PROPAGATION OF VERY LOW FREQUENCY RADIOWAVES IN THE ARCTIC REGION DURING POLAR CAP TYPE ABSORPTION

N. I. Fedyakina *In its* Probl. of the Arctic and the Antarctic 1970 p 463–472 refs (See N71-22801 11-13)

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Analysis of the behavior of VLF signals during six polar cap absorption (PCA) cases revealed: (1) During polar cap absorption along routes passing through the Arctic region, the normal diurnal variation of the signal level on 18.6 kHz was upset. The signal strength under complete illumination of the radioline, either remained approximately at the same level, or rose by up to 15%. (2) The diurnal variation during PCA cases occuring in summer months was reversed. (3) After the PCA was no longer recorded, the signal level continued to remain anomalous for sometime, which may be regarded as an indirect indication of the continued arrival of protons in the terrestrial atmosphere. (4) In one case an anomalous rise of the signal started 14 hours before PCA and coincided in time with a series of flares of intensity on the sun. (5) During only one day, when the instruments did not record absorption, was there a case of anomalous VLF propagation observed. It was assumed that in this case there was also a protonic effect. A.L.

N71-22901 Advisory Group for Aerospace Research and Development, Paris (France).

PHASE AND FREQUENCY INSTABILITIES IN ELECTROMAGNETIC WAVE PROPAGATION

Kenneth Davies, ed. (ESSA, Boulder, Colo.) Slough, Engl. Technivision Serv. Jul. 1970 752 p refs Mostly in ENGLISH; partly in FRENCH 13th Symp. (11th Tech. Meeting) of the Electromagnetic Wave Propagation Comm., Leicester, Engl., [1969] (AGARD-CP-33) Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The composition of the transmission medium and its effects in degrading the phase and frequency of an electromagnetic signal are studied. Covered is a wide frequency range from about 10 kHz to optical waves. For individual titles see: N71-22902 through N71-22960.

N71-22903 Environmental Science Services Administration, Boulder, Colo. Research Labs.

EFFECT OF NORMAL IONOSPHERIC FLUCTUATIONS ON PROPAGATION OF VLF SIGNALS TO GREAT DISTANCES

D. D. Crombie *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 35–44 refs (See N71-22901 11-07)

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An attempt is made to explore the use of a very simple qualitative model of the earth ionosphere waveguide for estimating the effects of height irregularities on VLF propagation. Formulae are developed for the temporal, frequency, and spatial correlation coefficients of the signal and are compared with available measurements of these quantities. Reasonable agreement is obtained. Author

N71-22904 Applied Research Lab., Waltham, Mass.

PHASE VELOCITY VARIATIONS OF VLF WAVES

J. Galejs *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 45–53 refs (See N71-22901 11-07)

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Propagation characteristics of VLF waves are computed in the presence of a dipping static magnetic field for frequencies used in navigational systems. For East to West night time propagation the computed velocity changes by about 1 per cent at dip angles of 25 to 30 deg, where the n = 1 mode exhibits an absorption peak. For West to East direction of propagation the computed phase velocities of the individual modes are nearly independent of the dip angle, the attenuation rates are lower than for East to West direction of propagation and the second mode may predominate at small distances from the source and for smaller values of the dip angle. The relative amplitudes of the two modes depend on

the dip angle and on the distance, and the apparent phase velocity of the resulting waves may change by about 3 per cent. During polar cap absorption conditions, the phase velocity is increased by about half a per cent relative to daytime conditions and it is independent of the direction of propagation or of the dip angle. Author

N71-22905*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

STATISTICAL MEASUREMENT OF SPECTRAL AMPLITUDE AND PHASE OF ATMOSPHERICS IN THE VLF RANGE

H. Volland, G. Heydt (Heinrich-Hertz-Inst.), and W. Harth (Bonn Univ.) *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 55–70 refs Prepared in cooperation with the Heinrich-Hertz-Inst. fuer Schwingungsforsch. and Bonn Univ. Astron. Inst. (See N71-22901 11-07)

(NASA-TM-X-67136) Copyright. Avail: NTIS; Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido) CSCL 20N

Equipment has been developed which within the VLF range allows the measurements of the statistical spectral amplitude distribution, the ratio of the spectral amplitude at two different frequencies and the statistical group time delay of the phase of the spectral amplitude of atmospherics coming from discrete thunderstorms. The group time delay is directly related to the phase of the propagation function within the atmospheric waveguide and depends on distance, azimuth, frequency, and effective height of the waveguide. Its variations with frequency and time have been measured for different thunderstorms. They give evidence of the time change of the ionospheric reflection characteristics within the VLF range. The statistical treatment of the atmospherics allows a quantitative determination of the number of lightning flashes within the thunderstorm. Author

N71-22906 Royal Aircraft Establishment, Farnborough (England).

OBSERVATIONS OF PHASE VARIABILITY OF 200 Hz DIFFERENCE FREQUENCIES DERIVED FROM VLF TRANSMISSIONS OBTAINED OVER LARGE DISTANCES

B. Burgess *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 71–76 refs (See N71-22901 11-07)

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The 226 2/3 Hz phase modulation frequency of the 13.600 kHz carrier and also the 262 Hz frequency derived from the reception of the 10.2 and 10.462 kHz transmissions from OMEGA Trinidad have been monitored aboard a high speed aircraft. The aircraft flights took place either in conditions of total darkness or total daylight over the propagation paths. The phase delay variability of the 226.2/3 Hz and the 262 Hz frequencies were measured with reference to the phase delay of the carrier frequencies. The main fluctuations of these phase measurements as a function of distance can be attributed to the modal interference of the first two least attenuating waveguide modes. Even at a carrier frequency of 10.2 kHz this modal interference effect is extremely large at ranges of at least 7000 km from the transmitter under night conditions. These effects are substantiated by analysis of field strength/distance measurements on the carrier frequencies. The importance of these observations in the context of navigation systems is discussed. Author

N71-22907 Heinrich-Hertz-Institut fuer Schwingungsforschung, Berlin (East Germany).

OBSERVATIONS OF DIURNAL AMPLITUDE AND PHASE VARIATIONS ON 16 kHz TRANSMISSION PATH AND INTERPRETATION BY A SIMPLE PROPAGATION MODEL

J. Frisius *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 77–86 refs (See N71-22901 11-07)

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Results of amplitude and phase measurements on a 16 kHz transmission path are presented by use of a set of two propagation parameters: the equivalent reflection height h prime, and a real parameter alpha, which characterizes the effective reflection attenuation. These parameters are not bound to specific D region models and describe the propagation over distances of about 300 to 1200 km with sufficient accuracy. By means of theoretical contours of constant amplitude and phase in an h prime - alpha - plane the variation of h prime and alpha with time can be derived from amplitude and phase records. Special attention has been given to the sunrise effect. The types of amplitude and phase records, which are observable at Lindau, have been reduced to a few characteristic paths of the propagation model in the h prime - alpha - plane during the sunrise effect. This description permits the comparison of the observed effects with aeronomical theories. Author

N71-22908 Radio and Space Research Station, Slough (England).

CALCULATION OF COMBINED FIELD OF GROUND WAVE AND ONCE REFLECTED SKY WAVE OF A VLF TRANSMITTER AT DISTANCES UP TO 500 km

B. R. May *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 87–95 refs (See N71-22901 11-07)

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It is shown how full-wave calculations of the ionospheric reflection coefficient can be used with a stationary phase technique to estimate the combined field of a once reflected sky wave and the ground wave at distances up to 500 km from a VLF transmitter. Two D region electron density distributions are used, representative of day and night conditions at summer, sunspot maximum and results at frequencies of 5, 10 and 15 kHz are presented. From a study of the calculated ground interference patterns it appears that in general the deviations in phase and amplitude from that of a simple free space ground wave are greater by night than by day. Calculations for a frequency of 10 kHz show that azimuthal variations in the interference patterns are relative unimportant at these short distances from the transmitter. Frequencies in the band 10 to 15 kHz appear to be slightly more suitable for navigational and time-or-frequency-standard purposes for the distance range, due mainly to the smaller calculated reflection coefficients at these frequencies than at 5 kHz. Author

N71-22909 Battelle Inst., Frankfurt am Main (West Germany).

PHASE INSTABILITY IN CONNECTION WITH POLARIZATION VARIATIONS

U. Troeger *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 97–102 refs (See N71-22901 11-07)

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In order to estimate the bearing errors to be expected in direction finding when using a loop antenna, experiments were made on the polarization of 21.4 kHz transmissions. DF measurements made by using a cross-loop antenna, revealed apparent bearing deviations up to 30 deg which were caused by the elliptical polarization of ionospheric waves. Investigations of the elliptical polarization have shown that ellipticity coefficients up to 0.4 and polarization angles up to 35 deg occur. Phase recordings of

anomalous and normal components of the magnetic field strength showed a 1.5 times greater mean phase velocity for the anomalous component than for the normal component. Author

N71-22910 Kiruna Geophysical Observatory (Sweden).
VLF SIGNAL PHASE INSTABILITIES PRODUCED BY PROPAGATION MEDIUM: EXPERIMENTAL RESULTS
F. H. Reder (Inst. for Exploratory Res., Deal, N.J.) and S. Westerlund *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 103–138 refs Prepared in cooperation with Inst. for Exploratory Res., Deal, N.J. (See N71-22901 11-07)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

Utilization of the full potential of highly phase stable VLF signals in an undisturbed propagation medium requires a clear understanding of perturbations produced by transmitter and reception equipment. Signal phase instability for a quiet ionosphere is discussed in terms of diurnal and seasonal phase variations, and degrading effects due to mode conversion and mode interference. Phase instabilities during ionospheric disturbances have six primary sources: SID's affecting daytime phase at all latitudes; PCA-s causing drastic and long lasting daytime and nighttime phase advances on paths traversing the polar caps; relativistic electron precipitation at higher latitudes leading to moderate phase advances during several hours; aurorae affecting to some degree nighttime phase stability of VLF signals into or through the auroral zone; geomagnetic storms perturbing mostly the nighttime phase at all latitudes and leading occasionally to slow and moderate daytime phase advances along higher latitude paths; and unspecified disturbances altering the mode structure of some transmissions at night, thereby causing substantial phase fluctuations. Author

N71-22911 Max-Planck-Institut fur Aeronomie, Lindau Uber Northeim (West Germany). Inst. Fuer Ionosphaeren-Physik.
PHASE DEVIATIONS ON LONG DISTANCE VLF PROPAGATION OVER HIGH LATITUDES
G. Lange-Hesse and K. Rinnert *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 refs p 139–144 (See N71-22901 11-07)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

Continuous phase and amplitude recordings are made on the signals of two VLF transmitters; one propagation path crosses the arctic polar cap and the other passes south of the auroral zone. The diurnal changes in phase and amplitude of these two signals received are very different. The propagation of the VLF radio waves over the transpolar path can be described by a single mode; mean phase deviations of nighttime propagation are closely connected with the actual geomagnetic activity. The signal of the other transmitter consists of several modes. Generally this causes characteristic diurnal changes in phase and amplitude which are different from the trapezoidal diurnal changes. These characteristic diurnal phase and amplitude changes are influenced by disturbed ionospheric reflection, but no correlation of the mean phase deviation with the geomagnetic activity is found. Author

N71-22912 Leicester Univ. (England). Dept. of Physics.
ANOMALIES IN PHASE AND AMPLITUDE OF IONOSPHERICALLY PROPAGATED VLF RADIOWAVES DUE TO THE EFFECTS OF SOLAR FLARES
T. B. Jones and I. C. Wand *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 145–154 refs (See N71-22901 11-07)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The phase and amplitude of 19.6 kHz transmissions have been monitored continuously and marked anomalies in these parameters have been observed during solar flares. An attempt is made to account for the disutrbances in terms of the flare enhanced solar X-ray spectrum and the resulting increase in D region electron density. The D region continuity equations are solved as a function of time, using a numerical method, giving the electron density profile at various times within the flare burst and during the decay period. The flare spectra recorded by the Ariel satellite during quiet and disturbed conditions are used for these calculations. The effects of the disturbed D region on VLF propagation are computed by means of a full wave method and it is shown that the X-ray burst gives rise to a decrease in the phase height of reflection and sometimes an amplitude enhancement, but more often a decrease, in the conversion coefficients. The calculated decay time is longer than that observed at steep incidence for most flares and it is suggested that this is the result of an increase of the ratio of negative ions to electrons in the lower ionosphere. Author

N71-22913 Environmental Science Services Administration, Boulder, Colo. Research Labs.
ON THE THEORETICAL INSTABILITY OF PHASE OF LF AND VLF TERRESTRIAL IONOSPHERIC WAVES
R. Ralph Johler *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 155–180 refs (See N71-22901 11-07)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The phase perturbations and instabilities in ionospheric propagation influence the precision of radio navigation and timing systems; continuous wave (CW) systems are directly influenced by the ionospheric disturbances and pulsed ground wave systems experience ionospheric wave contamination by lowered ionospheric reflection heights during such disturbances. Also, the rate of change of phase with time after a disturbance influences the error rate of frequency shift keying teletype systems used in conventional communications. For these reasons a theoretical model of an ionospheric disturbance is constructed and its effect on the phase correction at LF and VLF propagated in the terrestrial waveguide is described. Author

N71-22914 Naval Electronics Lab., Center for Command Control and Communications, San Diego, Calif.
TIME DISSEMINATION EFFECTS CAUSED BY INSTABILITIES OF THE MEDIUM
E. R. Swanson *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 181–198 refs (See N71-22901 11-07)
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The effects of pertinent parameters of the medium on the dissemination of time are discussed. Time is defined generally to include both frequency and epoch. Time dissemination is affected by both the repeatability and predictability of the medium. Repeatability affects both frequency and epoch; predictability primarily affects dissemination of epoch. The relationships between the statistical properties of the medium and the accuracy to which time can be disseminated are developed. Two schemes are considered: lead-edge pulse techniques, and phase tracking techniques. Both schemes may be used to distribute epoch in addition to frequency, provided a means is available to resolve the inherent ambiguity in phase tracking to a usefully long period. In either case, the precision of the epoch is determined by the phase measurements after acquiring the correct time period. Factors affecting prediction are also discussed briefly. Author

N71-22915 Brussels Univ. (Belgium).
RECEPTION OF LOW FREQUENCY TIME SIGNALS
D. Andrews (Office of City Engr., Loveland, Colo.), C. Chaslain, and J. De Prins *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 199–217 refs (See N71-22901 11-07)
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The possibilities of clock synchronization using time signals transmitted at low frequencies are considered. The study was made by observing pulses emitted in Switzerland and in the United States. The results show that the low frequencies are preferable to the very low frequencies at distances up to about 800 km in middle latitudes. Measurements show that by carefully selecting a point on the decay curve of the pulse it is possible at distances from 100 to 1000 kilometers to obtain time measurements with an accuracy of + or − 40 microseconds. A comparison of the theoretical and experimental results permits the study of propagation conditions and shows the desirability of transmitting seconds pulses with fixed envelope shape. Author

N71-22916 National Bureau of Standards, Boulder, Colo.
SOME STATISTICAL PROPERTIES OF LF AND VLF PROPAGATION
D. W. Allan and J. A. Barnes *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 219–232 refs (See N71-22901 11-07)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Eng. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

A statistical analysis has been conducted on day-time phase fluctuations of the standard frequency and time radio stations. The results of the analysis yielded a spectral density of the time fluctuations proportional to the reciprocal spectral frequency for the propagation noise on both radio stations. For flicker noise phase modulation a good model of the standard deviation of the fractional frequency fluctuations is formed. A cross-correlation coefficient of −0.6 was found between both radio stations; a linear combination of the two transmissions improved the flicker noise level allowing a precision of frequency measurement of 1 x 10 to the −12th power for a nine day average any time of the year and of 1 x 10 to the −12th power for a five day average over the summer months. Author

N71-22917 Air Force Cambridge Research Labs., Bedford, Mass.
CALCULATED EFFECTS OF ELECTRON DENSITY IRREGULARITY ON PROPAGATION OF 100 kHz RADIOWAVES
Samuel Horowitz *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 233–238 refs (See N71-22901 11-07)
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Utilizing a full wave solution, the effects of a perturbation in the electron density profile of a model exponential ionosphere on the complex reflection coefficients have been calculated and are discussed in terms of the wave fields generated. The phase and amplitude of the reflected signal are shown to be sensitive to the hight of electron deposition particularly at the main reflection level. Author

N71-22918 Naval Electronics Lab. Center for Command Control and Communications, San Diego, Calif.
EFFECT OF OFF PATH REFLECTIONS ON PHASE AND AMPLITUDE FLUCTUATIONS AT VLF
E. E. Gossard and M. R. Paulson *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 239–249 refs (See N71-22901 11-07)
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A short radio path is used to measure the spatial and temporal characteristics of fluctuations of VLF signals. The experiment uses multiple frequency transmissions from a horizontal VLF antenna received at a triangle of spaced receivers. Power spectrum and cross spectrum analyses of the phase and amplitude records are used to demonstrate that much of the fluctuation in the records results from Doppler beating of the principle signal with off-path components. The position and movement of the off-path reflectors can be deduced from the records. Several typical records are shown and some implications concerning previous published analyses of fading records are discussed Author

N71-22919 Environmental Science Services Administration, Boulder, Colo. Research Labs.
THE 'CORRELOID' AS A MEANS OF GENERALIZING RANDOM PHENOMENA
L. S. Fedor and J. W. Wright *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 251–265 refs (See N71-22901 11-07)
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Developed is a least squares method for obtaining the correloid from spaced-sensor cross-correlations. The method assures a best fit of the assumed form of the correloid to the assembly of available correlation sections and provides a straightforward method of calculating the mean drift and the parameters of random motion of the quantity measured. The formulation, application, and some results of the use of this method are described, particularly for the case of phase and amplitude variations of an ionospherically propagated signal. Author

N71-22920 Communications Research Center, Ottawa (Ontario).
GEOPHYSICAL CONSIDERATIONS OF LW PROPAGATION
John S. Belrose *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 267–280 refs (See N71-22901 11-07)
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Various experimental techniques are employed to study the lower ionosphere, e.g., partial reflections, wave interaction, long wave (LW) propagation (frequencies 10 - 1000 kHz), LW ionospheric sounding, and medium frequency (1 - 3 MHz) absorption measurements. Riometers which measure changes in radio wave absorption at some high frequency (10 - 60 MHz) are one of the most useful and exploited techniques to study the larger absorption events which frequently occur at high latitudes. The use of LW propagation is considered, particularly emphasing the importance of phase measurement, as a tool for geophysical research. A brief summary of the experimental methods with emphasis on those methods most useful for geophysical research is presented and some results are given. Author

N71-22921 Lowell Technological Inst. Research Foundation, Mass.
LOWER IONOSPHERIC INSTABILITY OBSERVED WITH MF DOPPLER-SHIFTED SIGNALS
J. R. Herman and J. Waaramaa *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 281–294 refs (See N71-20901 11-07)
(Contract AF 19(628)-4801)

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The spatial variability of the lower ionosphere has been investigated during night time using continuous wave, medium frequency signals received aboard a fast-moving aircraft whose motion introduces Doppler shifts which are different for the ground-wave and sky-wave components. Power spectrum analysis of the received signal allows separation of these two components from which the arrival angle, reflection height and electron density i.e., plasma frequency or equivalent vertical frequency can be determined. Application of this airborne Doppler technique to medium frequencies, together with the requisite digital analysis, is described and the results of two night flights made during geomagnetically quiet conditions are discussed. On the first flight reflection heights of 75 to 105 km with associated electron densities of approximately 1000 to 4000 per cm were observed. Both E- and F-layer reflections were seen on the second flight. Author

N71-22922 Westinghouse Electric Corp., Boulder, Colo. Georesearch Lab.

GEOPHYSICAL CONSIDERATIONS IN RADIO TIMING SYSTEMS

L. Ball and G. Hefley (ESSA, Boulder, Colo.) *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 295-310 refs Prepared jointly by Westinghouse Corp., Boulder, Colo. and ESSA, Boulder, Colo. (See N71-22901 11-07)

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The time stability of the LF ground wave is well known; however, anomalous phase variations over land are very poorly understood. Prescribed are initial attempts to reconcile various phase measurements with existing ground wave theory and possible applications of existing geophysical technology to explain observed phase perturbations in a mountainous region are suggested. Using surface impedance concepts on a flat earth, it is shown that large conductivity contrasts, such as exist in major fracture zones, cause variations on the total field in the vicinity of the fault zone. These field perturbations represent significant phase errors in timing systems. Author

N71-22923 Kansas Univ., Lawrence. Div. of Engineering Science.

GEOPHYSICAL EXPLORATION IN POLAR AREAS WITH VLF ELECTROMAGNETIC WAVE PROPAGATION

A. W. Biggs *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 311-318 refs (See N71-22901 11-07)

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Geophysical exploration in polar areas is described with the phase variations found in very low frequency (VLF) electromagnetic wave propagation over stratified and mixed path terrain. Results are presented for propagation paths from homogeneous ice to sea water, layered ice to sea water, and sea water to homogeneous ice. The recovery and dropoff effects are found for the mixed paths with homogeneous media. Some of the phase variations found in layered media are markedly different from those in homogeneous media. Author

N71-22924 Royal Australian Air Force Academy, Melbourne.

PHASE INSTABILITY IN RADIO WAVES PROPAGATING ACROSS ICE COVERED SEAS

I. A. Bourne, D. B. Ross (Commun. Res. Centre) and B. Segal *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 319-329 refs Prepared jointly by Roy. Australian AF Acad. and Commun. Res. Centre (See N71-22901 11-07)

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Experimental measurements and theoretical calculations are presented which show that the presence of a thin layer of ice on a sea's surface can have a marked influence on the propagation of medium frequency waves across the sea. It is found that under certain conditions small changes in the ice thickness can result in marked changes in the phase of a received wave. Author

N71-22925 Army Electronics Command, Fort Monmouth, N.J.

MEASUREMENTS OF ELECTROMAGNETIC FIELD OF AN ANTENNA IN A 9000 FOOT HOLE

M. Acker and L. J. Mueller *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 331-336 refs (See N71-22901 11-07)

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As part of a study to determine the electrical characteristics of the Earth's crust, electromagnetic measurements were made of the radiated field from a transmitting antenna placed in a 9000 foot hole. The transmitting antenna consisted of a single wire excited by a medium power transmitter and the receiving antenna was a ground probe. The experimental data consisted of phase measurements of the radiated signal on the surface of the earth. The received signal phase was measured by a pair of atomic frequency standards operating in conjunction with a transmitting and a correlation type receiving system. The signal phase was then determined by a simple graphical comparison with the transmitted reference signal stored in the receiver. The resulting data revealed large instabilities in phase over a period of several consecutive days and a measurement run of six weeks later which indicates multimode phenomena. Author

N71-22926 Forschungs Institut fuer Hochfrequenzphysik, Werthhoven (West Germany).

GEOGRAPHICAL DISTRIBUTION OF ELECTRICAL GROUND PARAMETERS AND EFFECTS ON NAVIGATIONAL SYSTEMS

H. J. Albrecht *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 337-347 refs (See N71-22901 11-07)

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The electrical behavior of ground types encountered in all parts of the world is shown on maps indicating average values and their changes due to climatological conditions. A formula based on an average relationship between conductivity and relative dielectric constant is employed to arrive at complete ground data for any path and for any seasonal condition. Thus ground effects are determined for navigational systems operating with transmitter and receiver above and below the surface. With regard to buried antennae being utilized at one or both points, it is even more essential to know the exact electrical performance of the ground. Again the average changes can be predicted if the geographical distribution of ground parameters is known. Author

N71-22927 Forschungsinstitut fuer Hochfrequenzphysik, Werthhoven (West Germany).

NEW MEASUREMENTS CONCERNING NATURAL GROUND AS VARIABLE PROPAGATION MEDIUM

H. J. Albrecht and D. Kaczmarczyk *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 349-355 refs (See N71-22901 11-07)

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Investigations on subsurface propagation of the indirect type have been conducted with variable ground conditions in the antenna environment. Results were obtained by using continuous recordings covering a variety of climatological conditions in typical ground. The influence of the various types of precipitation, of partly frozen and progressively freezing ground, and of drier periods are discussed in detail. Results for lower frequencies are presented as well as data collected on frequencies of the order of 1000 MHz. The transparency of the earth's surface on these frequencies has been one of the major objectives. Its variability is discussed with respect to climatological effects on the ground environment.
Author

N71-22928 Environmental Science Services Administration, Boulder, Colo.

INTERPRETATION OF IONOSPHERIC RADIO DRIFT MEASUREMENTS: SOME RESULTS OF EXPERIMENTAL COMPARISONS WITH NEUTRAL WIND PROFILES

J. W. Wright *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 357–372 refs (See N71-22901 11-07)

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About 100 radio spaced-receiver drift measurements are compared with 40 neutral wind measurements in the nighttime E region by gun - and rocket-launched self-luminous trails. The radio result correctly detects the direction of neutral wind throughout the wide range of wind azimuths permitted by nighttime sporadic E layers, provided that frequencies below the blanketing frequency are employed in the measurement. A systematic behavior of the errors in partially reflecting cases is found. The magnitude of the radio echo drift velocity agrees with that of the neutral wind only if the point source effect is invalid for normal incidence radio sounding. Otherwise, the radio experiment detects speeds which are about half that of the wind.
Author

N71-22929 Hawaii Univ., Honolulu. Dept. of Electrical Engineering.

DETECTION OF IONOSPHERIC INSTABILITIES WITH A DOPPLER TECHNIQUE

P. F. Weaver and P. C. Yuen *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 373–388 refs (See N71-22901 11-07)

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Since 1964 the instantaneous frequencies of signals from Maui have been measured at Honolulu (a distance of about 150 km) with an accuracy better than 0.1 Hz. The data show that changes in the ionosphere occur continuously through both day and night. During typical days Doppler shifts of about + or − 1 Hz are seen on the 10 MHz signal. On disturbed days Doppler shifts of + or − 3 Hz or larger are seen. Doppler shifts caused by ionospheric changes due to sunrise, sunset, solar flare effects, and sudden magnetic commencements have been recorded and identified. Other instabilities which have been recorded include Z-traces, due to an ionosphere producing several reflections; multiple signals, which may correspond to a number of different propagation modes; and long-period and short-period fluctuations due to compression waves in the ionosphere.
Author

N71-22930 Avco Corp., Lowell, Mass. Space Systems Div.

DOPPLER EFFECTS OF ATMOSPHERIC DISTURBANCES ON HF RADIO PROPAGATION

D. G. Detert and C. A. Moo *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 389–403 refs (See N71-22901 11-07)
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Observation of perturbations in the instantaneous received frequency of phase-stable high frequency radio transmissions provides a sensitive technique for studying the passage of atmospheric waves at ionospheric heights. Doppler variation data showing dynamic interaction effects on HF transmissions at vertical incidence and around-the-world are presented. The frequency spectra of these variations exhibit diverse and sometimes unexpectedly large Doppler effects, including the presence of wave-like disturbances which can occasionally be related to other geophysical phenomena. Preliminary results of the effects on vertical propagation of the static firing of large rocket engines are described; dispersions associated with magnetic disturbances on a 10,000 km path and RTW are presented. Ray tracing simulations are used to show that the anomalous Doppler effects can result from the motion of ionospheric waves through the great circle HF transmission paths and illustrating the dependence of Doppler variation magnitudes on certain features of the signal raypaths.
Author

N71-22931 Centre National d'Etudes des Telecommunications, Saclay (France). Division des Previsions Ionospheriques.

FREQUENCY INSTABILITY OBSERVED AND CALCULATED FROM THE RECEPTION OF A SHORT WAVE PROPAGATED BY THE IONOSPHERE [INSTABILITE DE FREQUENCE, OBSERVEE ET CALCULEE, A LA RECEPTION D'UNE ONDE COURTE PROPAGEE PAR L'IONOSPHERE]

C. Baloud *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 405–420 In FRENCH (See N71-22901 11-07)

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A ray tracing method and propagation characteristics calculations are used to determine received frequency variations in relation to different transmission paths. Main objectives are to determine the real ionization profiles from vertical ionogram deviations. Obtained results are compared with experimental registrations of Doppler deviations through spectral analysis by joining corresponding deviations to the different paths. Agreement between calculated and registered frequency deviations is reasonably satisfactory. The program makes it also possible to interpretate registered values in terms of length, single or multiple propagation and propagation paths.
Transl. by G.G.

N71-22932 Stanford Research Inst., Menlo Park, Calif. Radio Physics Lab.

DETECTION AND ANALYSIS OF PROPAGATING ION ACOUSTIC WAVES IN THE IONOSPHERE

A. F. Wickersham *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 421–437 refs (See N71-22901 11-07)

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Propagating acoustic-like disturbances generated by nuclear explosions have been observed to split into two disturbances in the lower ionosphere. The two disturbances propagate vertically into the upper ionosphere at different speeds, the slower at ordinary sound speed in a neutral medium and the faster at almost twice the speed of sound. The faster disturbance travels at the speed of an ion-acoustic wave in the ionic fluid. Such identification is prohibited theoretically by the large damping, or coupling, of the

ionic mode to the neutral particle medium through ion-neutral elastic collisions; however, if inelastic collisions are included in the theory, the principal exothermic charge-exchange reactions in the ionosphere provide enough additional coherent momentum in the charged particles to offset the losses through elastic collisions. It is shown quantitatively that in some regions of the ionosphere ion-acoustic wave propagation can occur almost losslessly. Author

N71-22933 Stanford Research Inst., Menlo Park, Calif. Radio Physics Lab.

SPATIAL AND TEMPORAL MODEL OF THE TID FROM A LOW ALTITUDE NUCLEAR EXPLOSION

D. P. Kanellakos *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 439–454 refs (See N71-22901 11-07)

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Ionosonde records from various Pacific stations were analyzed following megaton-range, low altitude nuclear explosion. The response of the F2 region of the ionosphere to the passage of neutral, atmospheric waves generated by the explosion was determined. It was found that the presence of the geomagnetic field introduced asymmetries in the phase of the response of the ionization changes in the F2 region. The electron density fluctuations were in phase with the neutral particle fluctuations north of the explosion point and south of the magnetic equator, and out of phase south of the point and north of the magnetic equator. The velocity of the leading edge of the disturbance was expanding at a constant velocity of 770 m/sec. The electron density change, which is proportional to the product of the period and amplitude of the neutral wave, varied slowly with range up to about 3000 km from the explosion point but rapidly decreased with range between 3000 and 6550. In addition, the electron-density fluctuations varied with azimuth. Author

N71-22934 Symbionics, Waltham Mass.

LOCALIZED LOW ALTITUDE SOURCES AND ACOUSTIC GRAVITY WAVE PERTURBATIONS OF THE IONOSPHERE

R. V. Row *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 455–462 refs (See N71-22901 11-07)

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A sufficiently large low altitude detonation generates a propagating disturbance in the ionosphere which can be observed with high frequency radio sounding equipment as oscillatory variations of virtual height, critical frequencies or Doppler shift. The onset of such disturbance propagates with velocities in the vicinity of 700 – 800 m/s characteristic of the speed of sound in the neutral atmosphere above heights of about 140 km. The onset is followed by a rapid build up and long period oscillatory decay. The apparent period of the oscillation increases from several tens of minutes to a few hours as the observing range from the source increases from say 1000 to 4000 km or more. Data from two detonations showing this behavior are reviewed, as well as some data taken at the time of the great Alaskan earthquake of March 1964. A simple theoretical model of an unbounded atmosphere has been shown previously to predict this behaviour. The consequences of some recent improvements on this model which include both space and guided modes are discussed. Author

N71-22935 Environmental Science Services Administration, Boulder, Colo. Research Labs.

FREQUENCY VARIATIONS OF IONOSPHERIC RADIO SIGNALS CAUSED BY BURSTS OF SOLAR RADIATION

Kenneth Davies *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 463–478 refs (See N71-22901 11-07)

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Frequency instabilities induced in ionospheric radio echoes by bursts of solar X-rays (5-100 A) and ultraviolet rays (100-1000A) are discussed. The relaxation time of the E-F1 regions of the ionosphere determined from the negative, or recovery, stages of these sudden frequency deviations (SFD) is found to be about 35 sec. Examples are shown in which the F echoes have relatively large frequency deviations that fluctuate with periods of the order of 10 sec, but in which the frequency deviations of the E echoes are small and vary smoothly with time. This suggests that the short X-rays vary smoothly during an SFD, whereas the extreme ultraviolet fluctuates. The value of the ionosphere as a spectrum analyzer of solar radiations is shown to be limited by the ionization characteristics of the atmospheric molecules. Author

N71-22936 Doshisha Univ., Kyoto (Japan). Dept. of Electronics.

SFDS AND THE RECOMBINATION COEFFICIENT IN THE IONOSPHERE

Toru Ogawa *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 479–483 refs (See N71-22901 11-07)

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Sudden frequency deviations, SFD's have been used to determine the effective recombination coefficient in the E region. The value thus obtained is about 10 to the –8th power ccm/sec. In some cases the recovery stage of the SFD could best be explained in terms of two different recombination coefficients. Author

N71-22937 Leicester Univ. (England). Dept. of Physics.

SFDs IN IONOSPHERICALLY PROPAGATED HF RADIOWAVES DUE TO EFFECTS OF SOLAR FLARES

I. C. Wand and T. B. Jones *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 485–495 refs (See N71-22901 11-07)

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The marked increases in ionizing radiations known to occur during solar flares produce rapid changes in the ionization density of the ionosphere which give rise to perturbations in the frequency of HF radiowaves reflected from the E and F layers. Assumptions are made regarding the time and wavelength dependence of the ionizing flux changes during a flare and the relevant continuity equation is solved with respect to time for various heights in the ionosphere to give the rate of change of excess electron density at all times during an event. A ray tracing program has been used to calculate the frequency deviation from the enhanced electron density profiles. The variation of frequency deviation with sounding frequency is found to differ for X-ray and some EUV enhancements. Author

N71-22938 Stanford Research Inst., Menlo Park, Calif.

HF PROPAGATION DISPERSION

J. B. Lomax *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 497–510 refs (See N71-22901 11-07)

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A series of comprehensive measurements on HF signals

show that the first- and second-order statistics of the received signal are typically indistinguishable from the statistics of a Gaussian random process. This is true not only when the signal is the result of a number of propagating echoes, but for signals received via a single path as well. The time and frequency dispersion of single echoes are discussed and are shown to be quite small under quiet ionospheric conditions. Examples of power spectra and the distribution of observed values of frequency spread for a 4100-km mid-latitude path and a 5050-km transauroral path are also presented. A model for HF propagation is proposed which considers the propagation channel in terms of its scattering function. The signal amplitude, group delay, and rate of change of phase-path delay are computed for each component. This allows the prediction of the time and frequency spread of the received signal, in addition to the usual signal-to-noise ratio. Author

N71-22939 Air Force Cambridge Research Labs., Bedford, Mass. Ionospheric Radio Physics Branch.

FREQUENCY VARIATIONS OF AN OBLIQUE 5 MHz IONOSPHERIC TRANSMISSION

Kurt Toman *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 511–520 refs (See N71-22901 11-07)

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A 5 MHz transmission originating on the east coast of the United States was received 604 km from the transmitter. At the receiving end narrow filters were employed to separate the carrier frequency from the upper-side-band frequencies. The 5 MHz carrier frequency was heterodyned to 500 kHz and compared with a 500 kHz reference signal of an oscillator whose frequency stability was about 1 part in 10 to the 9th power. The diurnal frequency variation of the 5 MHz ionospheric signal was obtained for days selected from the year 1965. Optimum frequency stability was observed near noon. For 24 March 1965 the diurnal behavior of the 600 Hz modulation phase was obtained. Virtual height data for an ionosonde station located near the midpoint of the path were compared with Doppler frequency variations. Author

N71-22940 Max-Planck-Institut fuer Aeronomie, Lindau, uber Northeim (West Germany).

PHASE-PATH DIFFERENCES OBSERVED BY SWEEP FREQUENCY BACKSCATTER MEASUREMENTS

H. Moeller and H. Stiewitt *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 521–533 refs (See N71-22901 11-07)

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Sweep frequency measurements were carried out with a peak pulse power of 300 kW. On summer daytime records obtained with southerly directed rhombic antennas interference like patterns are observed in a frequency range of 20 MHz through 32 MHz. It is assumed that this phenomenon is connected with the appearance of dense E sub s layers. The interference pattern can be explained by a model which assumes a reflection at very dense E sub s clouds and Faraday rotation in the normal E layer. Phase-path differences calculated according to this model yield an interference pattern consistent with the observation. Author

N71-22941*# Illinois Univ., Urbana. Ionosphere Radio Lab.

EFFECTS OF IONOSPHERIC IRREGULARITIES ON STABILITIES OF WAVE AMPLITUDE AND PHASE IN SPACE COMMUNICATION

C. H. Liu and K. C. Yeh *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 535–544 refs (See N71-22901 11-07)

(Grant NsG-24)
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Electron density irregularities cause any wave propagating through them to have unstable amplitude and unstable phase. Since the wave is actually sensitive to changes in the refractive index, irregularities near the peak of the F region dominate. Therefore, a reasonably simplified model in connection with space communication problems is the problem of propagation through a slab of irregularities. Amplitude and phase fluctuations have been computed for a number of cases. It has been found that for a given set of conditions, the extraordinary waves will suffer more than the ordinary waves. But the difference diminishes as the frequency increases. If the wave when transmitted is linearly polarized, the received wave may be depolarized due to scattering. The depolarization has been studied for a number of cases. A number of curves will be shown as different parameters are varied. Author

N71-22942 General Electric Co., Syracuse, N.Y.

IONOSPHERIC PHASE FLUCTUATIONS OF SATELLITE TRANSMISSIONS

G. H. Millman and R. E. Anderson *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 545–560 refs (See N71-22901 11-07)

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The coherent frequencies of 162 and 324 MHz emitted from the GEOS-1, Explorer 29 satellites were utilized for the study of the phase fluctuations imposed by irregularities in the ionosphere. The observations were conducted at a midlatitude station (42.85 N, 74.07 W) in May and June 1966. From accurate frequency measurements, the total columnar electron content was determined by the Doppler slope method for approximately overhead satellite passes at closest approach. The spatial variation of the electron content was deduced from the differential phase measurements recorded throughout the satellite passages. At times, unusual phase fluctuations were observed which were most likely caused by ionospheric inhomogeneities located in the path of propagation. The characteristics of the phase fluctuation data are presented. Correlation of all the experimental data with solar geophysical conditions is also discussed. Author

N71-22943 Army Electronics Command, Fort Monmouth, N.J. Inst. for Exploratory Research.

MOMENTARY COMPARISONS OF AMPLITUDE, FREQUENCY AND POLARIZATION INSTABILITIES IN SIMULTANEOUSLY EMITTED SATELLITE RADIO SIGNALS

P. R. Arendt and H. Soicher *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 561–566 ref (See N71-22901 11-07)

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A new polarization following system for the measurement of momentary values of the Faraday rotation polarization angle of 40/41 MHz satellite-emitted radio signals. This system affords the continuous observation of small fluctuations of the total polarization angle which are interpreted as determining the fine structure of the integrated electron content. Polarization variations were observed together with simultaneous Doppler frequency scintillations on 20, 40 and 41 MHz. The frequency scintillations are a sensitive tool for exploring ionospheric turbulence and local refractive effects. While both types of scintillation are related to horizontal gradients and time variations of the electron densities, different mechanisms are applicable. A grid-like ionospheric structure is indicated by

polarization measurements. This structure explains simultaneously-observed strong amplitude scintillations as diffraction effects. The data support the thesis that amplitude scintillations are related to ionospheric irregularities of enhanced ionization (clouds) as well as decreased ionization (holes). Author

N71-22944 Paris Univ. (France). Lab. de Physique de l'Atomosphere.

STUDY OF IONOSPHERIC IRREGULARITIES BY CALCULATION AND MEASURING OF DOPPLER EFFECTS AND FARADAY DIFFERENTIALS [ETUDE DES IRREGULARITIES IONOSPHERIQUES PAR LE CALCUL ET LA MESURE DES EFFETS DOPPLER ET FARADAY DIFFERENTIELS]

R. Hanbaba, J. Papet-Lepine, and B. de Vaublanc *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 567–574 refs In FRENCH (See N71-22901 11-07)

Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10802 (Attn. Mr. A. L. Candido)

Experimental arrangements for exact measurements of differential Doppler effects by artificial satellites are used to observe propagation irregularities through phase deviation measurements between two emission frequencies. A ray tracing program is proposed for determining regular and irregular wave paths of the two frequencies. After reaching predetermined propagation lengths at known heights, variations in differential Doppler effects that correspond to the ionosphere can be deducted. The difference between the obtained curve and the experimental curve gives the effects of disturbances on the phase of the received signal. Composition and density of the heterogeneous medium responsible for this phase deviation can be approximated from experimental curve deviations. Transl. by G.G.

N71-22945 Radio and Space Research Station, Slough (England).

TROPOSPHERIC STRUCTURE IN RELATION TO PHASE STABILITY

J. A. Lane *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 575–585 refs (See N71-22901 11-07)

Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

Recent studies of the refractive index variations in the atmosphere up to a height of several kilometres are reviewed and the results compared with theoretical models of tropospheric structure. Measurements with refractometers and thermometers on aircraft, balloons and towers, together with soundings with centimetric radar, generally show a considerable degree of inhomogeneity. The intensity and scale size of the refractive index fluctuations vary considerably in space and time and with varying dynamic stability. Measured spectral characteristics are reviewed in relation to various assumptions made in theoretical work on phase and amplitude fluctuations. Special reference is made to results which illustrate the limitations of theories based on the concept of isotropic, homogeneous turbulence. Meteorological observations made simultaneously with measurements of variations of the effective length of microwave line-of-sight links show some correlation between changes in effective path length and changes in water vapor density and in refractivity. Author

N71-22946*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

EFFECT OF ATMOSPHERIC VARIATIONS ON HIGH PRECISION TRACKING

Paul Reichley *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 586–596 refs (See N71-22901 11-07)

(Contract NAS7-100)
(NASA-CR-117804) Copyright. Avail: NTIS; Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido) CSCL 20N

The classical ray equation is inverted by perturbation techniques, yielding analytic approximations up to second order for the effects of the Earth's atmosphere on range Doppler and angle of a high frequency electromagnetic wave through the atmosphere. The method holds for a completely general spherically symmetric index of refraction which may in the same problem successively describe the troposphere, ionosphere and interplanetary medium. Assuming an exponential index of refraction for the troposphere, these effects in the Mojave Desert were studied for the year 1966; The measurements were obtained on an hourly basis and yielded the variations in scale height and refractivity of the troposphere with particular emphasis on the effects at S band (2300 MHz). Author

N71-22947 Westinghouse Electric Corp., Baltimore, Md.

INSTRUMENTATION RADAR CAPABILITIES AND LIMITATIONS DUE TO THE PROPAGATION MEDIUM

P. R. Dax *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 599–612 refs (See N71-22901 11-07)

Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The effects of the instabilities of the propagation medium on the accuracy of modern tracking radars are studied. It is shown that the advent of wide bandwidth coherent radar systems has made it possible to measure range to a fraction of a wavelength. The measurement of angle however is limited by mechanical considerations so that accurate position is best obtained from two or more radars operating from a wide baseline. The effects of inhomogeneities in the troposphere are discussed. The conclusion is that the state of the art in radar has reached the point where the theoretical performance of the system exceeds the capabilities of the medium. Author

N71-22948 Environmental Science Services Administration, Boulder, Colo. Research Lab.

TROPOSPHERIC PROPAGATION EFFECTS ON PRECISE ELECTROMAGNETIC MEASUREMENT OF DISTANCE

M. C. Thompson *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 613–628 refs (See N71-22901 11-07)

Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The development of electronic devices and techniques has reached a stage where phase modulation introduced by the atmosphere is a serious factor in their utilization. It becomes important then to study the magnitude and nature of both the systematic and random atmospheric effects and to examine carefully the possibilities of making effective corrections for the systematic effects and averaging out the random effects. Some of the measurement techniques are described and some of the results from field experiments to date are discussed. Author

N71-22949 Environmental Science Services Administration, Boulder, Colo. Research Labs.

ATMOSPHERIC ERRORS IN ELECTROMAGNETIC DISTANCE MEASUREMENTS: ESSA HAWAII EXPERIMENTS 1966–1967

H. B. Janes *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 629–636 (See

N71-22901 11-07)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The errors contributed by the lower troposphere to microwave measurements of distance and angular position were studied. Primary emphasis has been placed on measurements involving ground-to-air propagation paths such as those used in microwave tracking systems. The experimental technique has, in general, consisted of placing equipment simulating the rocket or satellite transponder on a mountain top and recording continuously the apparent variations in position as observed by a simulated tracking system located at a lower altitude. All previous measurements under this program have been made with overland propagation paths in Hawaii and Colorado. Although much valuable information has come from these experiments there has been an obvious need for additional measurements made over water to establish the relevance of the overland data to existing systems. A series of experiments was undertaken using overwater propagation paths in Hawaii. These experiments are described briefly and some preliminary results of the analysis are shown. Author

N71-22950 California Univ., Santa Barbara. Dept. of Electrical Engineering.
WAVEFRONT STATISTICS IN 3.2 mm LINE OF SIGHT TRANSMISSION
G. R. Heidbreder and R. L. Mitchell (Technol. Serv. Corp.) *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 637–651 refs Prepared jointly with Technol. Serv. Corp. (See N71-22901 11-07)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

An experimental study of wavefront statistics in 3.2-mm wavelength CW transmission is described. The measurements were obtained on a 19-km horizontal path near sea level. Two receiving installations were used. One of these is an interferometer with variable element spacing along a horizontal baseline. Signal amplitudes at both elements and phase difference were recorded. Phase difference statistics and amplitude fluctuation correlations were obtained for station separations between 1 and 7 m under various meteorological conditions. The other receiving installation consists of a 4.57-m paraboloidal antenna and radiometer. The main beam of the antenna is 2.8-arc-min wide in free space and is measurably perturbed in a turbulent atmosphere. It may be scanned across a point source in a time short relative to the time constant of the atmospheric structure. Statistics of beam wander and average antenna patterns are presented. Statistics obtained with the two receiving installations are compared with each other and with existing theoretical results. Author

N71-22962 Forschungsinstitut fuer Hochfrequenzphysik, Werthhoven (West Germany).
VARIATIONS OF TROPOSPHERIC SCATTER PROPAGATION CAUSED BY CHANGING WEATHER SITUATIONS, AND PROBLEMS OF RELEVANT PREDICTIONS
H. J. Albrecht *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1971 p 659–664 refs Supported in part by West Ger. Min. of Defence (See N71-22901 11-07)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Cndido)

The variation of average signal attentuation in tropospheric scatter propagation was studied. New results are: (1) the assumption of hilly terrain causing turbulence has been examined and investigations have referred to a specially defined orographic parameter and the concept of a planetary boundary layer; (2) experimental data refer to one scatter link exclusively operated for research purposes. Results of main interest in this connection concern a pronounced correlation between periods of low field strength and the passage of weather fronts. Combining such data with results of side scatter tests yields new conclusions on the behavior of the propagation medium; and (3) a method of predicting commencements of signal decrease as well as its relative strength has been established. Criteria and new results are discussed. Author

N71-22963 Consiglio Nazionale delle Richerche, Florence (Italy). Centro Microonde.
PHASE CORRELATION MEASUREMENTS OF LASER BEAM PROPAGATED THROUGH TURBULENT ATMOSPHERE
P. Burlamacchi, A. Consortini, L. Ronchi, G. Toraldo di Francia (Florence Univ. Ist. di Fis. Super.) *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 665–672 refs (See N71-22901 11-07)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

An experimental investigation of the statistics of phase fluctuations, by an interferometric method, over short atmospheric paths at ground level derived the following quantities: (1) the statistical distribution of the phase shift fluctuations at two points of the wavefront as a function of the distance and (2) the structure function of the phase fluctuations, which represents the second moment of the above distribution. The results of a systematic investigation are presented and a comparison is given between the experimental results and the theoretical predictions. Author

N71-22964 Tetra Tech, Inc., Pasadena.
EFFECTS OF TURBULENT ATMOSPHERE ON PHASE AND FREQUENCY OF OPTICAL WAVES
H. Hodara *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 673–688 refs (See N71-22901 11-07)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

Reviewed are salient results that have come out of phase and frequency instability investigations in the optical region, a unification of these results and placing them in proper perspective with respect to remaining portions of the spectrum. All important results are obtained by simple physical reasoning partly based on geometrical optics and comparisons with existing ones in the literature. Author

N71-22965 Optical Science Consultants, Yorba Linda, Calif.
OPTICAL STRENGTH OF ATMOSPHERIC TURBULENCE, ITS MEASUREMENTS AND ITS EFFECTS ON OPTICAL HETERODYNE RECEPTION
D. L. Fried *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 689–702 refs (See N71-22901 11-07)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The optical strength of atmospheric turbulence is determined to within a constant of proportionality by the two-thirds power dependence of the Kolmogorov hypothesis. The constant of proportionality, C sub N squared, called the refractive index structure constant measures the optical strength of turbulence. The magnitude of optical effects can be calculated from C sub n squared. The effect of atmospheric turbulence in an infinite plane wave on coherent reception is determined by a quantity for the maximum signal-to-noise ratio achievable with an optical heterodyne

receiver in the atmosphere, the rms fluctuations of signal power, and with a characteristic wind velocity, the spread of the beat frequency. This quantity also determines the resolution obtainable in forming an image. Author

N71-22956 Perkin-Elmer Corp., Norwalk, Conn.
MEASUREMENT OF ATMOSPHERIC TURBULENCE VIA OBSERVATIONS OF INSTANTANEOUS OPTICAL BLUR FUNCTIONS
R. E. Hufnagel *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 703–709 refs (See N71-22901 11-07)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

Described are two novel methods for estimating atmospheric turbulence properties on the basis of ground based observations of instantaneous optical image distortions. These observations yield crude quantitative estimates of turbulence strengths in the middle and upper troposphere. Finally, these and other optically determined estimates are compared with published in situ directly measured results. Author

N71-22958 Environmental Science Services Administration, Boulder, Colo. Research Labs.
PRACTICALITY OF USING LIGHT BEAMS TO DISTRIBUTE LOCAL OSCILLATOR SIGNALS OVER LARGE ANTENNA ARRAYS
R. S. Lawrence, K. B. Earnshaw, and J. C. Owens *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 721–727 refs (See N71-22901 11-07)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

Maintenance of phase uniformity in the distribution of local oscillator signals is one of the major problems of microwave antenna arrays that extend for many kilometers. The irregular atmosphere limits the performance of optical systems through the introduction of variable optical path length. Presented are measurements of the magnitude of this effect and its importance to a proposed optical distribution system is discussed. The system involves the use of two colors of light and is a one way rather than a round trip system. An effective path length stability of 3×10 to the -8th power is predicted. Author

N71-22959 Environmental Science Services Administration, Boulder, Colo. Research Labs.
ELECTROMAGNETIC PHASE VARIABILITY AS A MEASURE OF WATER VAPOR AND TEMPERATURE VARIATIONS OVER EXTENDED PATHS
B. R. Bean and R. E. McGavin *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 729–744 refs (See N71-22901 11-07)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

In many applications the value of the water vapor density and of temperature is more meaningful if the measurement is integrated over an area or along a path rather than being made at a fixed point. With the development of radio and optical distance measuring techniques, integrated measurements are becoming practical over paths of tens of km. Accuracy to be expected from commercially available two frequency methods indicates that the absolute value of the integrated water vapor density can be determined to within approximately 2.75%, that of integrated temperature to within approximately 0.6%. The resulution to be expected is .02 gm/cu.m in water vapor density, 0.1 K in temperature. With improvement of available equipment the uncertainties in the absolute values are expected to be reduced to considerably less than 1%. The ultimate accuracy depends on the accuracies in the coefficients in the equations for refractive index. Author

N71-22984* Dorne and Margolin, Inc., Bohemia, N.Y.
NOSE CONE MOUNTED HEAT RESISTANT ANTENNA Patent
Arthur Dorne and Eugene E. Shube, inventors (to NASA) Issued 21 May 1968 (Filed 19 Jan. 1966) 4 p Cl. 343-708 Sponsored by NASA
(NASA-Case-XMS-04312; US-Patent-3,384,895;
US-Patent-Appl-SN-521754) Avail: US Patent Office CSCL 09E

This antenna is designed to reside beneath the ablative covering of a spacecraft and is placed in a removed portion of the heat shield. Simultaneously the antenna elements, which are also good conductors, do not introduce paths of high thermal conductivity through the ablative shield. The antenna comprises a plurality of adjacent layers of dielectric material formed of silica and achieve radiation patterns essentially as that which could be obtained with a similarly located radiator mounted in free space. The feed element and element are capacitively coupled to each radiating other so as to present a highly conductive heat path. Further, a heat sink which is mounted in a plane parallel to and adjacent to the third layer, is separated therefrom by an air gap which forms an insulating layer. Detailed descriptions accompany drawings of the device. E.M.C.

N71-23001* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DIGITAL TELEMETRY SYSTEM Patent
Marjorie R. Townsend and Paul M. Feinberg, inventor (to NASA) Issued 23 Apr. 1968 (Filed 28 Aug. 1964) 11 p Cl. 340-174.1
(NASA-Case-XGS-01812; US-Patent-3,380,042;
US-Patent-Appl-SN-392973) Avail: NTIS CSCL 09F

An apparatus is described to compensate for wow and flutter induced in telemetry systems that utilize a storage medium such as a tape recorder. Digital words are converted into a serial pulse train which is transmitted at a constant bit rate. A variable number of digital bits is added at the end of the serial pulse train associated with each word to result in a constant output bit rate thus compensating for tape recorder speed variations. Official Gazette of the U.S. Patent Office

N71-23026* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
REDUCED BANDWIDTH VIDEO COMMUNICATION SYSTEM UTILIZING SAMPLING TECHNIQUES Patent
Leonard R. Malling, inventor (to NASA) Issued 14 May 1968 (Filed 17 Aug. 1964) 7 p Cl. 178-6 Sponsored by NASA
(NASA-Case-XNP-02791; US-Patent-3,383,461;
US-Patent-Appl-SN-390251) Avail: US Patent Office CSCL 17B

A system for decreasing the time-bandwidth requirements in transmitting or storing information is described which includes a circuit for monitoring an input signal to indicate which portions are varying rapidly and which are not. The monitoring circuit controls a sampling circuit which samples the input signal at long intervals for those portions which vary slowly and at short intervals for those signal portions in which a rapid variation occurs. The samples are entered into a buffer storage apparatus which transmits the samples at regular intervals, regardless of the intervals between which the samples were taken. Marker signals indicating the invervals between which the samples were taken, are mixed with the samples for entry in the buffer.
Official Gazette of the U.S. Patent Office

N71-23098* Electrac, Inc., Anaheim, Calif.
OPTIMUM PREDETECTION DIVERSITY RECEIVING SYSTEM Patent

Louis Katz, Raymond W. Honey, and Victor R. Simas, inventors (to NASA) Issued 12 Sep. 1967 (Filed 20 Mar. 1964) 11 p Cl. 325-305 Sponsored by NASA
(NASA-Case-XGS-00740; US-Patent-3,341,778; US-Patent-Appl-SN-353644) Avail: US Patent Office CSCL 17B

Two independent diversity receiving channels, by action of automatic gain control (AGC) and phase-lock loops contained in each of the receiving channels, adjust the signals thereof so that the output intermediate frequency (IF) signals from both channels are equal in amplitude and phase coherent. The AGC voltages generated in each channel, in addition to controlling the level of the signal thereof, are measures of the signal to noise ratio (SNR) of the IF signal in the channel with which they are associated. The IF signals and the AGC voltages are applied to a novel combiner which includes two voltaged controlled attenuators (VCA's), and AGC weighting network, and a summing circuit. In the AGC weighting network the various AGC voltages are combined to produce a control voltage which is in turn applied to the VCA's. The signals from the VCA's, after being summed in the summing circuit, are then applied to a demodulator. Official Gazette of the U.S. Patent Office

08 COMPUTERS

Includes computer operation and programming; and data processing. For applications, see specific categories. For related information see also: 19 Mathematics

N71-22044# Lockheed Missiles and Space Co., Palo Alto, Calif.
FUNCTIONAL CONVERTER FOR THE PROCESSING OF FUNCTION INCREMENTS ACCORDING TO GIVEN INCREMENTS OF THE ARGUMENT
V. I. Dikii et al 1970 4 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Priborostr. (USSR), v. 13, no. 12, 1970 p 48-51
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

A functional converter producing quanta of function increments upon the onset of quanta of argument increments (elementary quanta) is described. The converter is constructed on the basis of a piecewise linear and step approximation. In conformity with the piecewise linear approximation, the range of x variation is separated into 128 line segments in 16 increments each, and in conformity with the step approximation, each line segment is quantized in independent and dependent variables. Author

N71-22093 National Physical Lab., Teddington (England). Div. of Computer Science.
PALANTYPE TRANSCRIPTION BY COMPUTER Final Report
W. L. Price Feb. 1971 43 p refs
(NPL-COM-SCI-45) Copyright. Avail: Issuing Activity

The computer transcription system of Palantype, British system of mechanical shorthand is described with regard to Palantype-English dictionary organization, the transcription program, some applications of the computer transcription system, and the cost estimates. It is concluded that the system may be applied to fast keyboarding in the field of computer typesetting and that the system may be made more viable by redesigning the keyboard and introducing a degree of automatic error correction. ESRO

N71-22094 National Physical Lab., Teddington (England). Div. of Computer Science.
COLLECTED PAPERS ON THE DEVELOPMENT OF THE PL-516 PROGRAMMING LANGUAGE
Donald A. Bell Jan. 1971 54 p refs
(NPL-COM-SCI-44) Copyright. Avail: Issuing Activity

Details of the recent developments of PL-516, the high level assembly language for the Honeywell DDP-516 computer, are given. The extensions include two dimensional arrays, compound conditions, and a much freer format for expressions. Other extensions of a more mundane nature are described, and a chapter is included which gives rule of thumb techniques for estimating quickly the length of machine code produced by any piece of PL-516 text. A description of three programs of general interest, which also provide realistic examples of PL-516 programing, is finally made. Author (ESRO)

N71-22101 Minnesota Univ., Minneapolis.
EXTENDED FORTRAN ALGEBRAIC MANIPULATOR WITH APPLICATIONS TO LINEAR PROBLEMS OF PHYSICS
Carl Duane Zimmerman (Ph.D. Thesis) 1969 97 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 70-5622

A system which is capable of both numerical and algebraic manipulations has been developed. The language in which the user presents his problem is an extension of FORTRAN. Variables can represent either numerical or algebraic quantities depending on their presence in an appropriate TYPE statement. A main goal in the development of this system is that of minimizing the changes necessary in translating a formal mathematical expression to a statement acceptable by this system. The entire system is written in FORTRAN. It includes a FORTRAN compiler which produces standard FORTRAN as its object language and a package of routines which perform algebraic manipulations. Dissert. Abstr.

N71-22107 Cornell Univ., Ithaca, N.Y.
ON THE FEASIBILITY OF VOICE INPUT TO AN ON-LINE COMPUTER PROCESSING SYSTEM
Howard Anthony Elder (Ph.D. Thesis) 1969 122 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 70-5983

An on-line digital computer processing system is considered in which an ordinary telephone is the complete terminal device, input to the computer being provided as a sequence of spoken words, and output to the user being audio responses from the machine. The feasibility of implementing such a system with a FORTRAN-LIKE algebraic compiler as the object processor is considered. Complete details of a specific word recognition program are given. This technique depends on three simplifying restrictions namely, a small vocabulary set, known speakers, and a moment of silence between each input word. Experimental results are presented giving error rates for different experimental conditions as well as the machine resources required to accommodate several users at a time. The results show that at this time it is both economically and logically feasible to handle at least 40 users at a time with an IBM 360/65 computer. Dissert. Abstr.

N71-22149# McGill Univ., Montreal (Quebec). Dept. of Mechanical Engineering.
COMPUTER GRAPHICS ON JOUKOWSKI AIRFOILS
J. H. T. Wu and P. P. Ostrowski [1970] 11 p refs
(TN-71-2) Avail: NTIS

Steady, incompressible flow about a Joukowski airfoil section is simulated using an IBM 360-75 digital computer and a Calcomp plotter. The effect of various transformation parameters as well as the streamline pattern and pressure distribution about the airfoil is illustrated. The values of the simulation technique as a teaching tool are demonstrated. The method is shown to be particularly useful for flow visualization as all the basic features of the Joukowski transformation and the potential flow streamline patterns are clearly depicted. Author

N71-22252# International Business Machines Corp., Houston, Tex. Data Processing Div.

KINOFORM FILTERING TECHNIQUES

J. C. Patau, L. B. Lesem, P. M. Hirsch, and J. A. Jordan, Jr. 1 Jul. 1970 38 p refs

(IBM-320-2378) Avail: NTIS

The techniques for determining a filter to be processed by the kinoform method which do not noticeably differ from those actually used in digital filtering are discussed. The choice of the technique, or type of operator, can differ for a given filtering process in that it has to be used in kinoform or digital processing. Some constraints are outlined which must be introduced when the method called one square-law detector is to be employed. From the results obtained, the kinoform appears to be a very powerful means of optical filtering that can be implemented in many situations where other optical filtering techniques cannot be used. Author

N71-22283# Australian Post Office Research Laboratories, Melbourne (Australia).

COMPUTER PROGRAMS FOR THE COMPUTATION OF SMOOTH GROUP DELAY CHARACTERISTICS

E. Rumpelt and H. Junghans Oct. 1970 20 p refs

(Rept-6106-ADD-1) Avail: NTIS

The mathematical background and the application of two computer programs are described which have been written for obtaining a smooth group delay characteristic from a moderate number of specified points. The program output is to be used as input for group delay equalisation programs. Author

N71-22422# Chicago Univ., Ill. Inst. for Computer Research.

INSTITUTE FOR COMPUTER RESEARCH Quarterly Report

Robert L. Ashenhurst 1 Aug. 1970 169 p refs

(Contract AT(11-1)-2094)

(COO-2094-2; QR-26) Avail: NTIS

Project support activities are summarized and six computer research tasks are described. The tasks are: (1) optimal scheduling rules for information processing systems, (2) information structure modeling of organizations, (3) the existence and calculation of mean sentence length for a context-free stochastic grammar, (4) numerical experiments on pair correlations and thermodynamics, (5) the fuzzy Tychonoff theorem, and (6) numerical experiments in collisionless systems. E.C.

N71-22545# Mitsubishi Heavy-Industries, Ltd., Tokyo (Japan).

ON LINE REAL TIME SYSTEM FOR EXPERIMENTAL DATA COLLECTION AND PROCESSING

Hirao Kawai and Katsuyoshi Arai Jan. 1971 13 p In JAPANESE; ENGLISH summary

(TB-69) Avail: NTIS

A new on-line system, COLTS (Computer Oriented Laboratory and Testing System), using the process computer IBM 1800 DACS and several unique terminals was developed. It was recognized that this new system can be employed advantageously for shortening the turn around time and decreasing the man powers that were required to fair amount for experimental data processing in the past. Author

N71-22548# California Univ., Livermore. Lawrence Radiation Lab.

COMPUTER PROCESSING OF GAS CHROMATOGRAPHIC DATA: QUANTITATIVE ANALYSIS OF FATTY ACID METHYL ESTERS USING AN OFF LINE MAGNETIC TAPE SYSTEM

Gary J. Nelson 22 Oct. 1970 43 p refs Presented at the Fall Meeting of the Am. Oil Chemists Soc., Chicago, 27 Sep.–1 Oct. 1970 Submitted for publication

(UCRL-72393; CONF-700938-1) Avail: NTIS

The off line processing of chromatographic data from fatty acid methyl ester mixtures by a large digital computer is described. The output of the gas chromatograph is recorded and stored on magnetic tape. The system takes the analog signal from the electrometer and converts it to digital form, adds a time base, and records the data using an incremental magnetic tape recorder. The data sampling rate can be varied from 0.05 to 5 times per second. The total number of samples per tape is limited only by the length of the tape. A 1200 foot reel can store up to 30 hours of gas chromatographic runs. The tape is processed by a CDC-6600 computer. The computer locates all peaks, determines the retention time, and calculates the mass percentage of each peak. Along with the numerical output, a CRT plot of the data is also generated by the computer. The program has provisions for baseline corrections and peak overlap. The program also incorporates corrections for detector nonlinearity and variation in detector response to different molecular species. The accuracy of the system is within 5% based on analysis of fatty acid methyl ester samples of known composition. Author

N71-22549*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

THE CODE WORD WIGGLE: TV DATA COMPRESSION

R. F. Rice 15 Jun. 1969 18 p refs

(Contract NAS7-100)

(NASA-CR-117846; JPL-TM-33-428) Avail: NTIS CSCL 09B

A variable length coding algorithm that is capable of adapting to the nonstationary nature of digital spacecraft data was developed for noiseless channel conditions. Performance equations are first developed for a suitable analytic model, and then applied directly to 6-bit, pulse code modulated television data. The adaptive algorithm adjusts to changes in picture activity by treating blocks of consecutive picture elements as individual data sources. Using a single 8 word binary code, output data rates remain close to element-to-element entropy values for each block (and therefore for each picture). The preliminary dynamic performance curves (average bits per pixel versus entropy per data block) are shown. Author

N71-22566*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Astrionics Div.

A MAGNETIC TAPE RECORDER FOR LONG OPERATING LIFE IN SPACE

E. Bahm *In its* JPL Quarterly Tech. Rev., Vol. 1, No. 1 Apr. 1971 p 116–124 refs (See N71-22551 11-30)

Copyright. Avail: NTIS HC$6.00/MF$0.95 CSCL 14C

Described is a tape recorder which uses a very simple mechanical system to transport the tape with very few possible failure modes. The simplicity of the tape transport has been achieved at the expense of added complexity of the electronic system. The resulting tape recorder is better balanced in its mechanical and electronic reliability. The test results with a feasibility model have been very encouraging. Author

N71-22575*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

DATA EDITING

June E. Thompson Washington Apr. 1971 13 p refs

(NASA-TM-X-2264; E-6060) Avail: NTIS CSCL 09D

An editing system has been developed for a large general time sharing computer. A dynamic editing display technique and a static microfilm method are described. These editing techniques have been used to reduce the cost of processing large volumes of research data and of eliminating redundant data. They have also been helpful to the engineer in detecting faulty instrumentation and defining processing instructions. Author

N71-22580# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

INTERACTIVE GRAPHICS DISPLAY SYSTEM FOR HYDROLOGIC ANALYSIS

K. M. Busness Dec. 1970 90 p refs
(Contract AT(45-1)-1830)
(BNWL-1525) Avail: NTIS

A computer controlled interactive graphics display system was developed to enhance the study of problems related to water resources and pollution control. A PDP-9 digital computer serves as the controller for a UNIVAC 1558 display console and graphics digitizing table. Supplemental data storage is provided by a fixed-head disc. Author

N71-22616*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

A SET OF FORTRAN 4 ROUTINES USED TO CALCULATE THE MASS FLOW RATE OF NATURAL GAS THROUGH NOZZLES

Robert C. Johnson Washington Apr. 1971 36 p refs
(NASA-TM-X-2240; E-6086) Avail: NTIS CSCL 09B

A set of FORTRAN 4 subroutines is presented that calculates the isentropic mass flow rate of natural gas through nozzles and also thermodynamic functions such as compressibility factor, entropy, enthalpy, and specific heat. The pressure range for these routines is 0.1 to 10 million newtons per square meter, and the temperature range is from 200 to 400 Kelvin. Three sets of independent variables are permitted. In addition to the plenum pressure and plenum temperature, the other independent variable may be either the nozzle-exit pressure, the nozzle-exit Mach number, or the nozzle-exit temperature. Author

N71-22707* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

DATA COMPRESSOR Patent

Edward C. Posner, Isidore Eisenberger, Tage O. Anderson, and Warren A. Lushbaugh, inventors (to NASA) Issued 13 Feb. 1968 (Filed 24 Jun. 1965) 13 p Cl. 340-172.5 Sponsored by NASA
(NASA-Case-XNP-04067; US-Patent-3,369,222;
US-Patent-Appl-SN-466875) Avail: US Patent Office CSCL 14B

A data compressor which includes a counter to provide a number or count at the end of selected observation periods is described. A binary type serial memory stores a selected number of ones, followed by a selected number of zeroes, which is read out at the end of each period. When the number of ones which are read out equals the number of observed events a zero is inserted among the ones. At the end of the period, the zeroes are dispersed among the ones, with the number of ones preceding each zero representing the number of events observed during a different period. Official Gazette of the U.S. Patent Office

N71-22710* Kinelogic Corp., Pasadena, Calif.

INCREMENTAL TAPE RECORDER AND DATA RATE CONVERTER Patent

David A. Ehrenfeld and Irving Karsh, inventors (to NASA) Issued 13 Feb. 1968 (Filed 16 Nov. 1965) 6 p Cl. 340-172.5 Sponsored by NASA
(NASA-Case-XNP-02778; US-Patent-3,369,223;
US-Patent-Appl-SN-508170) Avail: US Patent Office CSCL 14C

A data storage system capable of storing digital data in a high density format on magnetic tape is described. Data is recorded on the tape without requiring the tape to start and stop for each bit of information recorded. The sequence of operations during the record mode involves the use of two buffer storage sections, one of which stores the incoming data at the incoming data clock rate until it is filled, at which time the incoming data is switched over for reception to the other buffer storage section. The two buffer sections make it possible to record data at one rate and replay at another rate.

Official Gazette of the U.S. Patent Office

N71-22726# Joint Publications Research Service, Washington, D.C.

MECHANIZATION AND AUTOMATION OF CONTROL SYSTEMS

29 Mar. 1971 129 p refs Transl. into ENGLISH of Mekh. i Avtomatiz. Upr. (Moscow), no. 5, 1970 p 1-64
(JPRS-52745) Avail: NTIS

CONTENTS:

1. AUTOMATION OF SCIENTIFIC EXPERIMENTS AND SCIENTIFIC AND TECHNICAL PROGRESS p 3-7

2. ORGANIZATION AND COMPOSITION OF SYSTEMS FOR AUTOMATION OF SCIENTIFIC EXPERIMENTS K. D. Zhuk p 8-18 refs (See N71-22727 11-08)

3. PRINCIPAL TASKS PERFORMED BY EXPERIMENTAL AUTOMATION SYSTEMS B. M. Burmistenko et al p 19-25 refs (See N71-22728 11-08)

4. PROBLEMS OF PLANNING OF AN EXPERIMENT AUTOMATION SYSTEM B. N. Malinovskiy et al p 26-33 refs (See N71-22729 11-08)

5. MACHINE ALGORITHM FOR PROCESSING OF ACTIVE EXPERIMENTAL DATA V. I. Saprykin et al p 34-41 refs (See N71-22730 11-08)

6. ALGORITHM FOR PROCESSING EXPERIMENTAL DATA FOR DIGITAL MODELING OF DYNAMIC SYSTEMS IN REAL TIME V. T. Kulik et al p 42-47 refs (See N71-22731 11-08)

7. METHOD OF CALCULATION OF EXPENDITURES FOR CERTAIN METHODS OF RECORDING EXPERIMENTAL DATA V. D. Akulov et al p 48-53 refs (See N71-22732 11-08)

8. EXPERIMENTAL DATA PROCESSING SYSTEMS USING THE DNEPR-1 COMPUTER V. I. Skurikhin et al p 54-59 (See N71-22733 11-08)

9. PROBLEMS OF THE STRUCTURAL ORGANIZATION OF ONE CLASS OF SYSTEM FOR AUTOMATION OF SCIENTIFIC EXPERIMENTS M. M. Grudinin et al p 60-67 refs (See N71-22734 11-08)

10. CALCULATION OF CERTAIN INFORMATION CHARACTERISTICS IN A SYSTEM FOR AUTOMATION OF COMPLEX EXPERIMENTS B. N. Malinovskiy et al p 68-74 refs (See N71-22735 11-08)

11. ORGANIZATION OF TWO WAY INFORMATION EXCHANGE IN AN AUTOMATIC EXPERIMENTAL DATA PROCESSING SYSTEM B. I. Kovalenko p 75-79 refs (See N71-22736 11-08)

12. SYSTEM FOR AUTOMATION OF SCIENTIFIC EXPERIMENTS IN THE AREA OF ONCOLOGY A. T. Mizernyuk et al p 80-83 (See N71-22737 11-08)

13. ONE POSSIBLE APPROACH TO DATA REDUCTION IN SCIENTIFIC EXPERIMENT AUTOMATION SYSTEMS A. G. Yereshchenko p 84-86 ref (See N71-22738 11-08)

14. STRUCTURE OF DIGITAL COMPUTER DESIGNED FOR EXPERIMENTAL DATA PROCESSING SYSTEMS V. F. Sabadash, et al p 87-91 (See N71-22739 11-08)

15. SOME PROBLEMS OF OPTIMAL ARRANGEMENT OF FILES OF EXPERIMENTAL DATA IN LOCAL STORAGE UNITS K. D. Zhuk et al p 92-97 refs (See N71-22740 11-08)

16. SOME EVALUATIONS OF METHODS OF PRESENTATION OF INFORMATION TO AN OPERATOR K. G. Samofalov et al p 98-108 refs (See N71-22741 11-08)

17. PRECISION AUTOMATIC HEAT REGULATION DEVICES FOR SCIENTIFIC EXPERIMENTS (REVIEW) I. N. Bogayenko et al p 109-114 refs (See N71-22742 11-08)

18. A SPECIALIZED ANALOG DIGITAL CONVERTER FOR EXPERIMENTAL DATA PROCESSING SYSTEMS V. B. Reutov et al p 115-121 refs (See N71-22743 11-08)

19. FOREIGN EXPERIENCE IN AUTOMATION OF SCIENTIFIC EXPERIMENTS K. D. Zhuk et al p 122-126 refs (See N71-22744 11-08)

N71-22727# Joint Publications Research Service, Washington, D.C.

ORGANIZATION AND COMPOSITION OF SYSTEMS FOR AUTOMATION OF SCIENTIFIC EXPERIMENTS

K. D. Zhuk *In its* Mechanization and Automation of Control Systems 29 Mar. 1971 p 8-18 refs (See N71-22726 11-08)

Avail: NTIS

Algorithm elements for closed cycle control of complex scientific experiments are examined. The elements include a working hypothesis model of the object of study, the expected model, the program of experiments, an algorithm for experimental data computation and machine processing of experimental data formation, and the interpretation of the model concepts. Stages in the development of a scientific experiment automation system are analyzed. E.C.

N71-22728# Joint Publications Research Service, Washington, D.C.

PRINCIPAL TASKS PERFORMED BY EXPERIMENTAL AUTOMATION SYSTEMS

B. M. Burmistenko et al *In its* Mechanization and Automation of Control Systems 29 Mar. 1971 p 19-25 refs (See N71-22726 11-08)

Avail: NTIS

Software-related problems in a system for automation of scientific experiments are discussed. Mathematical modeling, experimental planning, data processing, and comparison and evaluation processes are reviewed. E.C.

N71-22729# Joint Publications Research Service, Washington, D.C.

PROBLEMS OF PLANNING OF AN EXPERIMENT AUTOMATION SYSTEM

B. N. Malinovskiy et al *In its* Mechanization and Automation of Control Systems 29 Mar. 1971 p 26-33 refs (See N71-22726 11-08)

Avail: NTIS

Systems engineering planning methodology of automation systems for complex experiments is considered. Queueing model and servicing mechanisms are analyzed. It is concluded that systems planning for the automation of experimental investigations should be divided into stages in which the identification, refinement, and optimization of system technical characteristics are performed. E.C.

N71-22730# Joint Publications Research Service, Washington, D.C.

MACHINE ALGORITHM FOR PROCESSING OF ACTIVE EXPERIMENTAL DATA

V. I. Saprykin et al *In its* Mechanization and Automation of Control Systems 29 Mar. 1971 p 34-41 refs (See N71-22726 11-08)

Avail: NTIS

Machine algorithm statistical characteristics for processing of experimental data are examined in terms of dispersion analysis and mathematical modeling of multifactors. An algorithm used in the optimization of electrochemical production processes is summarized. E.C.

N71-22731# Joint Publications Research Service, Washington, D.C.

ALGORITHM FOR PROCESSING EXPERIMENTAL DATA FOR DIGITAL MODELING OF DYNAMIC SYSTEMS IN REAL TIME

V. T. Kulik et al *In its* Mechanization and Automation of Control Systems 29 Mar. 1971 p 42-47 refs (See N71-22726 11-08)

Avail: NTIS

A data processing algorithm yielding results which are independent of the quantization period is described. A nonlinear system is analyzed. The algorithm is accurate for problems in which external measuring devices determine the quantization period. E.C.

N71-22732# Joint Publications Research Service, Washington, D.C.

METHOD OF CALCULATION OF EXPENDITURES FOR CERTAIN METHODS OF RECORDING EXPERIMENTAL DATA

V. D. Akulov et al *In its* Mechanization and Automation of Control Systems 29 Mar. 1971 p 48-53 refs (See N71-22726 11-08)

Avail: NTIS

Cost effectiveness in recording experimental data is considered. The relative values of three data recording techniques are compared: (1) magnetoelectric oscillographic recording on photographic film with chemical development, (2) magnetoelectric oscillographic recording on paper without chemical development, and (3) strip chart recording. E.C.

N71-22733# Joint Publications Research Service, Washington, D.C.

EXPERIMENTAL DATA PROCESSING SYSTEMS USING THE DNEPR-1 COMPUTER

V. I. Skurikhin et al *In its* Mechanization and Automation of Control Systems 29 Mar. 1971 p 54-59 (See N71-22726 11-08)

Avail: NTIS

Hardware and software features of the Dnepr 1 general purpose computer system are described. The system includes a unit for communication between analog and discrete information sources, analog output terminals, and other terminals which allow economic machine interaction with input sources and users. Block diagrams of the Dnepr 1 system are included. E.C.

N71-22734# Joint Publications Research Service, Washington, D.C.

PROBLEMS OF THE STRUCTURAL ORGANIZATION OF ONE CLASS OF SYSTEM FOR AUTOMATION OF SCIENTIFIC EXPERIMENTS

M. M. Grudinin et al *In its* Mechanization and Automation of Control Systems 29 Mar. 1971 p 60-67 refs (See N71-22726 11-08)

Avail: NTIS

Stages in planning an automation system for experimental investigations are analyzed. Determining process variables, approximating input flow in the servicing system using k-th order Erlang normalized flow, and selecting subsystem mathematical models are discussed, as well as determining computer time requirements. E.C.

N71-22735# Joint Publications Research Service, Washington, D.C.

CALCULATION OF CERTAIN INFORMATION CHARACTERISTICS IN A SYSTEM FOR AUTOMATION OF COMPLEX EXPERIMENTS

B. N. Malinovskiy et al *In its* Mechanization and Automation of Control Systems 29 Mar. 1971 p 68-74 refs (See N71-22726 11-08)

Avail: NTIS

Information processing system parameters are discussed. Parameters include: throughput capacity, mean speed of information processing and input devices, mean time spent by messages in the queueing system, memory capacity and usage, and waiting time for servicing messages. The system is intended to aid in increasing productivity, improving quality control, and reducing production cycle time. Author

N71-22736# Joint Publications Research Service, Washington, D.C.
ORGANIZATION OF TWO WAY INFORMATION EXCHANGE IN AN AUTOMATIC EXPERIMENTAL DATA PROCESSING SYSTEM
B. I. Kovalenko *In its* Mechanization and Automation of Control Systems 29 Mar. 1971 p 75–79 refs (See N71-22726 11-08)
Avail: NTIS

Three stages in carrying out computerized experimental investigations are summarized. They involve constructing initial hypotheses and generalized models, clarifying the models, and creating complex mathematical models and algorithms of the physical processes and phenomena being studied. E.C.

N71-22737# Joint Publications Research Service, Washington, D.C.
SYSTEM FOR AUTOMATION OF SCIENTIFIC EXPERIMENTS IN THE AREA OF ONCOLOGY
A. T. Mizernyuk et al *In its* Mechanization and Automation of Control Systems 29 Mar. 1971 p 80–83 (See N71-22726 11-08)
Avail: NTIS

The development of an oncological data processing system using a general purpose computer and a graphic input device is mentioned. A brief description is given of such a system comprising the Dnepr 1 computer, an ultraviolet microspectrophotometer, a dual-beam infrared prism spectrometer, an electron paramagnetic resonance device, single channel normalizing converters, and a selective communications control device. E.C.

N71-22738# Joint Publications Research Service, Washington, D.C.
ONE POSSIBLE APPROACH TO DATA REDUCTION IN SCIENTIFIC EXPERIMENT AUTOMATION SYSTEMS
A. G. Yereshchenko *In its* Mechanization and Automation of Control Systems 29 Mar. 1971 p 84–86 ref (See N71-22726 11-08)
Avail: NTIS

Experimental data reduction techniques are reviewed with consideration given to the minimum number of ordinates in a distortion-free characterization of the phenomena under investigation, instantaneous signal values at sensor outputs, sensor priority, and the extent of storage capacity filled. E.C.

N71-22739# Joint Publications Research Service, Washington, D.C.
STRUCTURE OF DIGITAL COMPUTER DESIGNED FOR EXPERIMENTAL DATA PROCESSING SYSTEMS
V. F. Sabadash et al *In its* Mechanization and Automation of Control Systems 29 Mar. 1971 p 87–91 (See N71-22726 11-08)
Avail: NTIS

Design features of a general purpose digital computer system are described. The system contains Dnepr 1 control components and Minsk 2 magnetic tape units. System specifications are that the computer be general purpose; input be synchronized, external, and program controlled; and the accumulator be independently controlled by the local control unit during the local operations. Switching of memory devices is performed by the local control unit upon computer command. E.C.

N71-22740# Joint Publications Research Service, Washington, D.C.
SOME PROBLEMS OF OPTIMAL ARRANGEMENT OF FILES OF EXPERIMENTAL DATA IN LOCAL STORAGE UNITS
K. D. Zhuk et al *In its* Mechanization and Automation of Control Systems 29 Mar. 1971 p 92–97 refs (See N71-22726 11-08)
Avail: NTIS

The problem is evaluated in matching the recording capacity of input circuits and devices with data on the process studied and computer capacity. The problem is reduced to that of a linear network. Author

N71-22741# Joint Publications Research Service, Washington, D.C.
SOME EVALUATIONS OF METHODS OF PRESENTATION OF INFORMATION TO AN OPERATOR
K. G. Samofalov et al *In its* Mechanization and Automation of Control Systems 29 Mar. 1971 p 98–108 refs (See N71-22726 11-08)
Avail: NTIS

Data reduction methods are analyzed and a quantitative cost criterion is developed. The cost analysis examines information retrieval effectiveness, absolute cost, and specific cost factors. The methods are applied to the planning of a display device for an automatic control system. E.C.

N71-22742# Joint Publications Research Service, Washington, D.C.
PRECISION AUTOMATIC HEAT REGULATION DEVICES FOR SCIENTIFIC EXPERIMENTS (REVIEW)
I. N. Bogayenko et al *In its* Mechanization and Automation of Control Systems 29 Mar. 1971 p 109–114 refs (See N71-22726 11-08)
Avail: NTIS

An overview is given on high precision temperature regulators for automatic control systems. Block diagrams are discussed for a regulator for thermoluminescence measurements, a regulator with a stabilized power supply, and a compensation temperature regulator. E.C.

N71-22743# Joint Publications Research Service, Washington, D.C.
A SPECIALIZED ANALOG DIGITAL CONVERTER FOR EXPERIMENTAL DATA PROCESSING SYSTEMS
V. B. Reutov et al *In its* Mechanization and Automation of Control Systems 29 Mar. 1971 p 115–121 refs (See N71-22726 11-08)
Avail: NTIS

Analog to digital converters are analyzed which use parallel voltage dividers with constant output impedance balance circuits and pulsed power supply of the bridge circuit. It is pointed out that, by changing the converter bridge electrical circuitry and using the pulsed power supply mode, measurements of electrical resistance of resistors, materials, and conductors are feasible. Author

N71-22744# Joint Publications Research Service, Washington, D.C.
FOREIGN EXPERIENCE IN AUTOMATION OF SCIENTIFIC EXPERIMENTS
K. D. Zhuk et al *In its* Mechanization and Automation of Control Systems 29 Mar. 1971 p 122–126 refs (See N71-22726 11-08)
Avail: NTIS

Trends in computerized processing of scientific data are surveyed. The primary trends in the development of scientific experiment automation systems abroad involve the creation of large compexes, combining the actual experimental installation with measurement apparatus and devices for calculation and processing of information. These complexes operate in real time. Author

N71-22748* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ERROR CORRECTING METHOD AND APPARATUS Patent

Gustave Solomon, Jack J. Stiffler, Tage O. Anderson, and Warren A. Lushbaugh, inventors (to NASA) Issued 12 Mar. 1968 (Filed 10 Nov. 1964) 11 p Cl. 340–146.1 Sponsored by NASA (NASA-Case-XNP-02748; US-Patent-3,373,404; US-Patent-Appl-SN-420245) Avail: US Patent Office CSCL 09B

An error-correcting system for use in a digital data communication system is described. The system comprises an encoding apparatus responsive to a digital data word for developing a maximal length shift register code word corresponding thereto. Means are also provided for deleting digits in selected positions of the developed code word to thus provide a punctured code word. This punctured code word is applied to the transmitting end of a communication channel which operates on the punctured code word to produce a received word at the receiving end of the channel. The channel may introduce random errors. Means are provided at the receiving end for developing a plurality of punctured cyclic permutations of the maximal length shift register code word. The received word is then compared with each of the punctured cyclic permutations. Official Gazette of the U.S. Patent Office

N71-22755 Purdue Univ., Lafayette, Ind.
OPTIMIZATION IN PCM, ADAPTIVE PCM AND DPCM SYSTEMS
B. R. Narayana Murthy (Ph.D. Thesis) 1969 151 p
Avail: Univ. Microfilms: HC $11.50/Microfilm $3.25 Order No. 70-8932

The transmission of digital data by PCM systems is considered. A simple, yet general, method of determining the optimum quantizer structure to minimize the m.s.e. is presented. The problem of optimum bit assignment to the n samples from a total of N bits is considered. Two general methods of solution are obtained, using the techniques of dynamic programming and classical optimization. When the total number of bits N is not fixed, the optimal value of N also is obtained. An adaptive quantization technique is also considered in which the quantization of data is based on the actual data magnitudes. For a specific example, the average m.s.e. is compared to the total m.s.e. in the optimized PCM system. When the data samples are correlated, PCM transmission by differential systems is considered. Dissert. Abstr.

N71-22764 New York Univ., N.Y. School of Engineering and Science.
SOME FACTORS AFFECTING VISUAL INFORMATION PROCESSING
Murray Greenberg (Ph.D. Thesis) 1969 77 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 70-9779

This research deals with a provisional model of visual information processing with sequential inputs. Using a computer-based cathode ray tube display system, letter and word pairs were presented for 28 different on-off time combinations with on-times ranging from 5 msec. to 50 msec. and off-times ranging from 1 msec. to 125 msec. The results suggest that on, off and total processing times affect per cent correct detections, and that while a gradual increase in per cent correct detections occurs up to about 50 msec. of total processing time, a marked discontinuity appears to occur approximately between 50 and 60 msec. of total processing time, with per cent correct detections jumping abruptly from about 40% correct detections to above 80% correct detections over a total processing time space of only 10 msec. Dissert. Abstr.

N71-22775*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
CONCATENATION OF SHORT CONSTRAINT LENGTH CONVOLUTIONAL CODES
D. Erickson *In its* The Deep Space Network, Vol. 1 15 Feb. 1971 p 46–51 refs (See N71-22766 11-30)
Avail: NTIS CSCL 09B

Several methods of decoding a concatenated pair of K = 6, V = 2 convolutional codes are investigated. It was found that none of the methods provides performance which is suitable for space channel application. Author

N71-22782*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MARK 3A SIMULATION CENTER EMR 6050-UNIVAC 1108 COMPUTER INTERFACE
C. F. Leahey *In its* The Deep Space Network, Vol. 1 15 Feb. 1971 p 88–92 ref (See N71-22766 11-30)
Avail: NTIS CSCL 09B

A description is given of the development, capabilities, and operation of the EMR 6050-Univac 1108 interface. The hardware and software approaches used to satisfactorily mate the two computers are explained. Author

N71-22783*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
INBOUND HIGH SPEED AND WIDEBAND DATA SYNCHRONIZERS
P. F. Peavler *In its* The Deep Space Network, Vol. 1 15 Feb. 1971 p 93–94 ref (See N71-22766 11-30)
Avail: NTIS CSCL 09B

The development and functions of the high speed and wideband data synchronizers are discussed. Functions of the system include accepting serial blocked digital data and control signals, synchronizing incoming data, converting serial data to computer words, and presenting these words to two digital computers. In addition, the synchronizers also detect and delete filler blocks. Author

N71-22784*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SFOF MARK 3A CENTRAL PROCESSING SYSTEM MODEL DEVELOPMENT
H. S. Simon *In its* The Deep Space Network, Vol. 1 15 Feb. 1971 p 95–102 ref (See N71-22766 11-30)
Avail: NTIS CSCL 09B

The results of two modeling studies that were performed during the early stages of SFOF Mark 3A development are described. The studies evaluate the performance of two real time operating systems and provide information on central processing unit utilization and response times during a simulated 24 hour time segment in the orbital phase of the Mariner Mars 1971 dual spacecraft mission. Author

N71-22785*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DIAGNOSTICS FOR THE MARK 3A CENTRAL PROCESSING SYSTEM: IBM 360/75 COMPUTER ON-LINE TEST ROUTINES
R. A. Wells *In its* The Deep Space Network, Vol. 1 15 Feb. 1971 p 103–106 refs (See N71-22766 11-30)
Avail: NTIS CSCL 09B

A family of real time on-line diagnostics was developed to check out all IBM 360/75 related components of the SFOF Mark 3A central processing system. Diagnostic requests are entered from a cathode ray tube display station, initiating concurrent tests of assorted user devices and communications links. A supervisory software monitor program coordinates execution and, where necessary, draws on the facilities of the operating system in each IBM 360/75 computer. Author

N71-22786*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
IBM 360/75 COMPUTER TIME INTERFACE
C. Zandell *In its* The Deep Space Network, Vol. 1 15 Feb. 1971 p 107–109 ref (See N71-22766 11-30)
Avail: NTIS CSCL 09B

The IBM 360/75 computer time interface and the capabilities of two custom-feature modifications of the IBM 360/75 are

described. The modified IBM 360/75 accepts signals from an existing time reference, provides GMT with 10-microns resolution, includes an interval timer, and provides programmable interrupts. Author

N71-22787*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
IBM 360/75-UNIVAC 1108 COMPUTER INTERFACE
C. Zandell *In its* The Deep Space Network, Vol. 1 15 Feb. 1971 p 110–112 ref (See N71-22766 11-30)
Avail: NTIS CSCL 09B

A serial synchronous communication method for short distances without the use of modems is described. Reducing the total resistance between the current mode drivers and receivers makes transmission lengths of 400 ft possible. External timing replaces the modem function, allowing the direct connection of serial synchronous devices. Author

N71-22897* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COUNTER AND SHIFT REGISTER Patent
Christian Smith, inventor (to NASA) Issued 19 Mar. 1968 (Filed 17 Dec. 1964) 9 p Cl. 235-92 Sponsored by NASA (NASA-Case-XNP-01753; US-Patent-3,374,339; US-Patent-Appl-SN-423412) Avail: US Patent Office CSCL 09B

A computer circuit performing both counting and shifting logic operations is described. Noncapacitive solid state components are arranged in a plurality of Nand gates and the entire circuit is designed to be miniaturized or integrated in a basic circuit. The simplicity of the matrix layout adapts the circuit to micromodular construction. All the elements used are at present available in miniature sizes thus minimizing the cost. Schematic diagrams of the device are included. E.M.C.

N71-23058* Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
PATTERN RECOGNITION
Hans L. Oestreicher *In* AGARD Principles and Pract. of Bionics 1968 p 81–97 refs (See N71-23053 11-05)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

Pattern recognition is one of the best understood biologically inspired methods of information processing and compression. Discussed are the fundamental principles and theories, the problems and difficulties of this information processing technique which makes it possible to select out of a large stream of signals, continuously presented by the environment, those data which are relevant for the achievement of a certain goal. The more successful attempts of designing artificial pattern classifying systems based upon adaptive and nonadaptive, statistical, heuristic and algorithmic procedures are reviewed and several examples of biological pattern recognition systems described. Author

N71-23061 Institute for Perception Research, Eindhoven (Netherlands).
POTENTIAL APPLICATIONS OF LEARNING SYSTEMS
J. F. Schouten *In* AGARD Principles and Pract. of Bionics 1968 p 169–172 ref (See N71-23053 11-05)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The application of learning systems, as in living beings, will be found in those circumstances where the system is repeatedly confronted with similar stimulus patterns which, by flexible circuitry and feedback of success or failure, lead to increasingly adequate response patterns. Author

N71-23062 Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio. Biodynamics and Bionics Div.
NEUROPHYSIOLOGICAL PRINCIPLES OF AUDITORY INFORMATION PROCESSING
J. R. Mundie *In* AGARD Principles and Pract. of Bionics 1968 p 173–196 refs (See N71-23053 11-05)
(AMRL-TR-68-186) Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

An interpretation of the function of the mechanical action of the inner ear is presented. This mechanical transformation changes a two dimensional pressure-time signal into three dimensions: distance along basilar membrane, displacement of basilar membrane and time. It is this three dimensional surface which is presented to the nervous system for further analysis. The interpretation of cochlear action suggests that it functions to segment the signal in time and spatially disperses it. Segmentation defines the length of signal being analyzed while spatial dispersion sets the stage for the nervous system to use population statistics. Selected neurophysiological data illustrate auditory nervous system function and an hypothesis is proposed which interprets these data in a meaningful manner. The most significant feature of this hypothesis is the development of a type of information coding named pulse density modulation. Author

N71-23075 California Univ., Berkeley.
PRINCIPLES OF NATURAL AND ARTIFICIAL INTELLIGENCE
H. J. Bremermann *In* AGARD Principles and Pract. of Bionics 1968 p 425–446 refs (See N71-23053 11-05)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

In order to understand the nervous system it is necessary to understand the tasks that it performs. Control of motion by feature extraction and heuristics as a means of reducing computational complexity and the use of functionals in the selection of features is discussed. It is shown that unconstrained optimization plays a role in many problems. Author

N71-23077 University Coll. of North Staffordshire, Keele (England).
DIGITS AND ANALOGUES
D. M. Mackay *In* AGARD Principles and Pract. of Bionics 1968 p 459–466 refs (See N71-25053 11-05)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The science of artificial intelligence currently runs into trouble by philosophically naive and indefensible claims for computing machines, and by showing that important human capacities are beyond the scope of digital machinery. Reviewed are recent attacks of the latter sort and the suggestion that the best kind of mechanism to meet such criticisms would combine discrete and continuous computer processes, in a manner somewhat analogous to the relation between quantal transitions and probability amplitudes in wave mechanics. Organized in hierachic fashion, such processes have rich possibilities of reproducing spontaneously and naturally the features of behavior that are normally considered to be characteristic of human mentality. Author

N71-23094# Academy of Sciences (USSR), Moscow. Scientific Council on Complex Problems of Cybernetics.
SEMINAR ON ERROR CORRECTING ENCODING IN COMPLEX SYSTEMS. ISSUE 1: SEQUENTIAL CODING AND DECODING FOR DIGITAL DATA SOURCES

V. N. Koshelev 1970 30 p refs In RUSSIAN Conf. held at Moscow, 1969
Avail: NTIS

A method is examined for direct sequential product encoding (derived from a discrete Markov information source) into input characters for a memory-less channel, and sequential decoding of an output sequence into source characters at the output. It is shown that when source entropy does not exceed channel capacity the decoding error probability will be comparable to known values for block transmission techniques. A so-called computed source entropy value is determined which, if the computed channel capacity is not exceeded, ensures that the average number of operations during the decoding of a single character is limited to a constant, independent of the coding delay. Transl. by E.C.

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N71-21860# Army Electronics Command, Fort Monmouth, N.J.
SOME EFFECTS OF FABRICATION PARAMETER VARIATIONS ON THICK FILM RESISTIVE ELEMENTS
William Weintraub Nov. 1970 39 p refs
(AD-717297; ECOM-3348) Avail: NTIS CSCL 9/1

A study of the interrelated effects of screen printing parameters on the yield of thick film resistive elements, in terms of uniformity and resistance values, demonstrated the impracticability of reducing the dimensions of resistor lines beyond the thickness provided by conventional 200-mesh screens and beyond lengths and widths of 30 mils. The effects of line orientation were found to be minimal, but nevertheless predictable, while those of the printing sequence were of great importance. Printing resistors below conductive terminations imparied electrical continuity. Analysis of width and resistance relations showed line perimeters to consist of a uniformly bevelled edge. Data are given to define this effect so as to provide a correction factor in circuit layout. A comparison of uniformity of resistances obtained on specially selected substrates compared with as-received substrates showed a minimum of improvement. Application of the aforementioned effects to the fabrication of a bias resistor network demonstrated a lack of control of untrimmed resistance values when extremely short lengths, located close to resistors of longer lengths, were printed. For resistors of equal width and of the same paste, proportionality between resistance value and length was obtained after modifications in procedure to reduce substrate irregularities for the resistor printings, and changing the conductor to one of a silverfree composition. Author (GRA)

N71-21911# Illinois Univ., Urbana. Gaseous Electronics Lab.
STUDY OF INFRARED SENSITIVITY OF RECOMBINATION LIGHT FOR DEVICE APPLICATIONS Semiannual Report, 1 Jun.–30 Nov. 1970
Henry Merkelo, James P. Kaplafka, and Ladislas Goldstein Nov. 1970 41 p refs
(Contract N00014-67-A-0305-0017)
(AD-717645; UILU-ENG-70-316; SAR-1) Avail: NTIS CSCL 9/1

The results obtained during the first semi-annual period on the study of the characteristics of the recently discovered sensitivity of recombination-light to infrared (IR) radiation are reviewed. The sensitivity of recombination light to IR-radiation has been demonstrated with approximately 0.1 eV IR-photon energies in all common noble gases and is shown to be consistent with an analysis based on the photo-destruction of atoms in near-ionization-limit quantum states dominantly formed in the recombination of atomic ions and electrons and, in the case of helium, also in the recombination of diatomic molecular ions with electrons. The effect of impurities is shown to be very pronounced in cases where ionization and/or excitation energy considerations are such that the formation of near-continuum states in the resulting recombination, the IR-sensitivity of recombination-light has been demonstrated in selected continuously excited systems as well as in pulsed operation. Author (GRA)

N71-21916 Columbia Univ., New York.
SYNTHESIS OF ASYNCHRONOUS SEQUENTIAL SWITCHING CIRCUITS
Chung-Jen Tan (Ph.D. Thesis) 1969 142 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 70-7083

The functional dependencies among the variables of a synchronous circuit are investigated. It is shown that with added conditions the partition pair method can be used to obtain good assignments. Certain structural properties peculiar to asynchronous circuits are also developed. A heuristic assignment procedure is formulated. It is demonstrated that this procedure requires much less time to compute than other existing procedures. It also results in relatively good assignments. A nontrivial upper bound on the amount of combinational logic elements needed for single transition time two level realization of any SOC-machine is also established. This upper bound can be easily computed for any given table. A procedure for economical circuit realization for unreduced tables is also presented. Finally, algorithms are developed for obtaining loop free circuit decompositions. The problem of reduced input variable dependence is studied in detail. Dissert. Abstr.

N71-21921# Naval Postgraduate School, Monterey, Calif.
AN ELECTRO-MECHANICAL ACOUSTIC IMAGING SCANNER ASSEMBLY
John Davis Pearson (M.S. Thesis) Dec. 1970 38 p refs
(AD-717586) Avail: NTIS CSCL 9/1

The design of a combined electro-mechanical acoustic image scanning assembly is described. Various acoustic imaging system techniques have demonstrated an ability to form underwater images at distances greater than those obtained by optical means. The scanning assembly utilizes a sixteen element linear transducer array mounted on the radius of an eight inch diameter circle at the focal plane of an acoustic lens. The line array is rotated at a constant speed of 400 RPM. Acoustic signals at 250 KHZ of approximately 26 db re 1 ubar at the transducers were sufficient to produce satisfactory detection. Author (GRA)

N71-21924# Harry Diamond Labs., Washington, D.C.
DOME FILTER DESIGN AND ANALYSIS PROGRAM
Richard T. Antony Oct. 1970 27 p
(AD-717307; HDL-TM-70-26) Avail: NTIS CSCL 9/5

One failing of the conventional Dome filter design is the need to arbitrarily specify a particular parameter, denoted S. The report presents curves relating S to the maximum phase error and the usable bandwith of the filter. A design modification is presented that increases the filter bandwidth for a given phase error without an increase in the circuit complexity. Finally, employing this modification, a discussion and listing are given of a computer routine that designs the circuit elements and plots the theoretical performance curves of a Dome filter pair for a given phase error requirement. Author (GRA)

N71-22012# Naval Postgraduate School, Monterey, Calif.
APPLICATION OF COHN'S SENSITIVITY THEOREM TO TIME DOMAIN RESPONSES
Alan Lee Dahlvig (M.S. Thesis) Sep. 1970 34 p refs
(AD-717491) Avail: NTIS CSCL 9/5

A sensitivity theorem by R. M. Cohn states that for linear resistive circuits the ratio of a fractional change in the d.c. input resistance to a fractional change in an internal resistance is equal to the square of the ratio of the current through that internal resistance to the d.c. input current. The theorem is extended to show the sensitivity of input impedance to changes in internal impedances for an arbitrary network at all frequencies. Equations are developed which show the relation between sensitivities and instantaneous power in the frequency domain. An extension to the time domain makes digital computer solutions possible. Author (GRA)

N71-22023# Naval Research Lab., Washington, D.C.
A NEW CLASS OF FERRITE PHASE SHIFTER FOR USE IN PHASED ARRAYS Interim Report
Lawrence R. Whicker Dec. 1970 33 p refs
(AD-717344; NRL-MR-2200) Avail: NTIS CSCL 9/5

This report describes a new class of ferrimagnetic reciprocal phaser. The phaser is a dual-mode reciprocal type which is capable of operating at high peak and high average power levels. Expressions for insertion phase variations are investigated. Expressions for variation in insertion phase as a function of ambient temperature are derived, as well as equations predicting insertion-phase changes resulting from high average power heating effects. Experimental data for an S-band phaser designed to operate at high peak and high average power levels are presented. A total change in insertion phase of 6.4 degrees for 1,000 watts average input power is computed and measured within experimental accuracy. The merits of this class of phaser for high power application are considered and compared with the nonreciprocal toroidal type. Author (GRA)

N71-22086# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANTENNA CONSTRUCTION [ANTENNYE SOORUZHENIYA]
N. P. Melnikov 28 Dec. 1970 60 p Transl. into ENGLISH from the Russian
(AD-717837; FTD-HC-23-779-70) Avail: NTIS CSCL 13/13

The book illustrates various Soviet designs in the construction of towers and masts (for radio and television antennas) and radiotelescopes. Author (GRA)

N71-22104 Ohio State Univ., Columbus.
DESIGN CONSIDERATIONS FOR INTEGRATED MICROWAVE LINEAR AMPLIFIERS
Walter Kruppa (Ph.D. Thesis) 1969 272 p
Avail: Univ. Microfilms: HC $12.40/Microfilm $3.50 Order No. 70-6818

An evaluation of various design alternatives for integrated microwave linear amplifiers is presented. Comparisons are made between different circuit configurations and between different integration technologies. Evaluation criteria include gain, bandwidth, stability, and impedance match. Extensive use of computer simulation is made in all analyses. Guidelines for a systematic design of microwave integrated amplifiers are developed. Some of the theoretical results are utilized in the design of experimental single and two stage amplifiers realized with tantalum thin film technology on alumina substrate with appliqued beam-lead transistors. The performance of these amplifiers is closely predicted using computer simulation which includes the major parasitic and distributed effects. Dissert. Abstr.

N71-22144# Naval Underwater Systems Center, New London, Conn.
APPROXIMATE RESULTS FOR THE MUTUAL ELECTROMAGNETIC COUPLING OF LOOPS OVER A HOMOGENEOUS GROUND
Peter R. Bannister 23 Nov. 1970 29 p refs
(AD-717351; NUSC/NL-3029) Avail: NTIS CSCL 20/14

Approximate expressions (of simple form) are obtained for the mutual electromagnetic coupling loops over a homogeneous ground by employing image theory. The coupling cases considered are for vertical and horizontal coplanar loops, vertical coaxial loops, perpendicular loops, and a horizontal coplanar loop and wire element. It is shown that the image theory results are in good agreement with previous numerical integration results. Some numerical values of the loop coupling are also presented. Author (GRA)

N71-22145# Naval Research Lab., Washington, D.C.
INTERCONNECTED 3 DB HYBRIDS AND PHASE SHIFTERS: A COMBINED SWITCH, PHASE SHIFTER AND ISOLATOR
Max L. Reuss, Jr. and Charles W. Young, Jr. Nov. 1970 24 p
(AD-717341; NRL-MR-2192) Avail: NTIS CSCL 9/5

Microwave circuits consisting of two 3 dB hybrids interconnected by nonreciprocal phase shifters have been used to form switches, circulators, etc. The report reviews the properties of these circuits and the multifunction devices (switch-isolators, switch-phase shifters, and switch-phase shifter-isolators) that can be built using these circuits. Use of multifunction devices can result in reduction of insertion loss which would be of advantage for high power applications. Author (GRA)

N71-22180°# Raytheon Co., Waltham, Mass. Microwave and Power Tube Div.
A MICROWAVE BEAM POWER TRANSFER AND GUIDANCE SYSTEM FOR USE IN AN ORBITAL ASTRONOMY SUPPORT FACILITY Final Report, 10 Dec. 1969 - 10 Dec. 1970
William C. Brown 10 Dec. 1970 135 p refs
(Contract NAS8-25374)
(NASA-CR-103090; PT-2931) Avail: NTIS CSCL 09E

A microwave beam is studied as a means of transferring power between satellites. Emphasis of the study is upon the basic elements of microwave power generation, transmission, and capture and rectification. Experimental work included an accurate measurement of overall dc to dc efficiency of 27% in a laboratory system, and a beam-riding vehicle capable of simultaneously receiving power and automatically positioning itself for maximum power transfer. Author

N71-22277# Instituto Nacional de Tecnica Aeroespacial, Madrid (Spain). Dept. de Equipo y Armamento.
DESIGN AND DEVELOPMENT OF THE ELECTRONIC PARTS OF AN INERTIAL SENSOR Final Report
Patricio de Las Morenas, Gregorio Alcol, and Miguel A. Soriano 15 Sep. 1970 83 p
(Contract ESTEC-678-69-AA)
Avail: NTIS

A description is given of an inertial sensor, which has to provide a fixed direction in space. For the development model a one axis system was employed. The system, electronic equipment, and tests are included. ESRO

N71-22282# Standard Electric Lorenz A. G., Stuttgart (West Germany).
CONSTRUCTIONAL AND TECHNOLOGICAL DEVELOPMENT OF EQUIPMENT FOR ELECTRONIC MODULES AND SUB-ASSEMBLIES [KONSTRUKTIVE UND TECHNOLOGISCHE ENTWICKLUNG VON BAUWEISEN FUER ELEKTRONISCHE BAUSTEINE UND FUNKTIONSGRUPPEN]
D. Fischer, P. Mitsch, and G. Wolpert Bad Godesberg, West Ger. Bundesmin. fuer Bildung und Wiss. Nov. 1970 123 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Bildung und Wiss.
(BMBW-FB-W-70-61) Avail: NTIS; ZLDI Munich: 25.30 DM

The bonding of flat packs to nonmagnetic printed circuit boards and the production of multilayer boards with reliably plated through-holes are described. For module stabilization, sealing materials and processes are investigated. The continuation of case design, the production of a prototype case, and the manufacture of multilayer boards are discussed. Following an explanation of the influence manufacturing processes have on the yield and the electrical properties of semiconductor chips, improved manufacturing and assembly methods are pointed out. For qualification tests, a basic specification for modules in hybrid technology is proposed. Author (ESRO)

N71-22365*# General Electric Co., Auburn, N.Y. Semiconductor Products Dept.

SILICON CONTROLLED RECTIFIERS WITH IMPROVED RADIATION RESISTANCE Final Report

R. F. Wentink 31 Oct. 1970 98 p refs

(Contract NAS3-11831)

(NASA-CR-72842) Avail: NTIS CSCL 09E

A 600 volt, 475 ampere SCR was designed and optimized to improve the nuclear radiation resistance to exposures of 5 × 10 to the 13th power nvt and 1 million rad. Theoretical device models were developed to analyze the SCR in a radiation environment and to predict consequent changes in device characteristics. Calculations were performed using numerical techniques to design a theoretically optimized structure characterized by a shallow diffused forward blocking junction, a narrow p-base and a highly sensitive gate using pilot triggering. Fabrication was attempted but difficulties were encountered in producing devices which exhibited the desired blocking voltage. This resulted from nonuniformities in the shallow diffused junction. In order to obtain a reasonable blocking voltage yield, it was necessary to increase the diffusion depth of the forward blocking junction. Since the latter adversely affects the radiation resistance, it was concluded that a definite trade-off exists between radiation resistance and available processing technology required for high current SCRs. Author

N71-22441# Aeronautical Research Labs., Melbourne (Australia).

A REFERENCE FREQUENCY GENERATOR AND MODULATOR FOR AN AIRBORNE DATA ACQUISITION SYSTEM

M. D. Card Jun. 1970 35 p refs

(ARL/FI-44) Avail: NTIS

A system for generating a series of accurate reference frequencies required for an airborne data acquisition system was developed. A balanced modulator enables the recording of a reference frequency together with a speech signal on a single track of an airborne analogue tape recorder. Author

N71-22565*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Telecommunications Div.

CALCULATION OF SPACE CHARGE FORCES IN THE ANALYSIS OF TRAVELING WAVE TUBES

H. K. Detweiler *In its* JPL Quarterly Tech. Rev., Vol. 1, No. 1 Apr. 1971 p 106–115 refs (See N71-22551 11-30)

Copyright. Avail: NTIS HC$6.00/MF$0.95 CSCL 09A

A comprehensive large signal traveling wave tube computer program has been developed for the study and design optimization of high efficiency space type tubes. A disk model (DDM) for the electron beam yields accurate predictions for tubes in which RF space charge forces are not the predominant factor in determining device performance. RF space charge effects can be very important in tubes designed for space flight applications. Thus, it is essential to include them in the computer calculations if accurate predictions of device performance are to be obtained. Expressions for the space charge fields, appropriate to the DDM representation of the electron beam, are presented and the methods used in the calculations are described. Author

N71-22573# Lincoln Lab., Mass. Inst. of Tech., Lexington.

FABRICATION OF FLEXIBLE LOOP ANTENNA

Michael L. Burrows, Arthur H. Levasseur, Edward B. Murphy, Ogden G. Nackoney, and Carl B. Swanton 5 Oct. 1970 45 p

(Contract F19628-70-C-0230)

(AD-717718; TN-1970-31; ESD-TR-70-314) Avail: NTIS CSCL 9/5

Three flexible loop antennas were fabricated for evaluation and testing as underwater, towed, ELF receiving antennas. The report presents a detailed description of the fabrication process and the materials used in the fabrication. Author (GRA)

N71-22574# Lincoln Lab., Mass. Inst. of Tech., Lexington.

AN ANALYSIS OF FINITE RISE AND FALL TIME CURRENT EXCITATION OF TRAPATT DIODES

Thomas G. Bryant and Jerry D. Welch 7 Jan. 1971 49 p refs

(Contract F19628-70-C-0230)

(AD-717720; TN-1971-2; ESD-TR-71-3) Avail: NTIS CSCL 9/1

It is shown that the square wave current excitation requires negative impedance terminations above the 5th harmonic. Since the harmonic amplitudes in a square wave decrease only as 1/n, harmonics as high as the 9th and 11th must be properly terminated to make the analysis realistic and to prevent premature avalanche. We have analyzed the TRAPATT operation using the same physical approximations for plasma formation and recovery as used in the previous square wave analyses. However, we have assumed a trapezoidal current waveform which contains primarily first and third harmonics with negligibly small higher harmonics. In this analysis the avalanche zone transit and portions of the plasma extraction process occur while the current is changing. The resulting device voltage is calculated as a continuous analytical function of time except during the plasma formation interval and the final saturated velocity phase of the plasma extraction interval, where an interpolated voltage waveform is obtained. Fourier analysis of the voltage waveform provides the device efficiency as well as the necessary circuit termination at the 1st and 3rd harmonics. Author (GRA)

N71-22656# Harvard Univ., Cambridge, Mass. Cruft Lab.

EXPERIMENTAL STUDY OF COUPLED LINEAR ANTENNAS IN AN INHOMOGENEOUS DISSIPATIVE MEDIUM

Thomas Sugimoto Dec. 1970 49 p refs *Its* Sci. Rept. No. 10

(Contract F19628-68-C-0030)

(AD-717699; AFCRL-70-0710) Avail: NTIS CSCL 9/5

An experimental investigation of a pair of coupled linear antennas in an inhomogeneous dissipative medium was made. The medium was obtained by diffusing a water solution of NaCl into a large block of agar agar gel contained in a wooden tank. The relative dielectric constant was approximately 78 while the loss tangent could be varied from 0.13 to 3.0 at 114 MHz, the frequency used throughout the investigation. Driving point admittances and current distributions were measured with the medium inhomogeneity oriented parallel to the axes of the antennas. Self and mutual input admittances were measured as a function of the antenna length (beta h = 0.3 to 2 pi in steps of 0.1). Symmetric and antisymmetric current distributions were measured for four different antenna lengths (h/lambda = 0.25, 0.50, 0.75, and 1.0). Each measurement was repeated for three antenna separations (beta/lambda = 0.125, 0.25, and 0.50). Self and mutual driving-point admittances were measured as a function of base separation (b/lambda = 0.25 to 1.5 in steps of 0.125) for four antenna lengths (h/lambda = 0.25, 0.50, 0.75, and 1.0) with the medium inhomogeneity direction perpendicular to the antenna axes. Also studies were the effects of a medium discontinuity at the input, nonidentical elements, and input aperture size on the measured input admittance. Author (GRA)

N71-22657# Air Force Cambridge Research Labs., Bedford, Mass. Ionospheric Physics Lab.

LOW FREQUENCY GROUND WIRE ANTENNA
Gary S. Sales and Alma Ganio 2 Dec. 1970 15 p refs
(AD-717692; AFCRL-70-9671; AFCRL-IP-169) Avail: NTIS CSCL 9/5

The impedance and radiation properties of a ground-wire antenna are analyzed using transmission line theory. For the purpose of computing these properties, considering the large number of parameters necessary to describe the antenna, a computer progam was developed. Several sample calculations are described, directed towards the design of an antenna for use with a low frequency stepped ionosonde. Author (GRA)

N71-22860 Tennessee Univ., Knoxville.
THE NONLINEAR PROPERTIES OF A DIODE BRIDGE NETWORK AND THE USE OF THESE PROPERTIES TO IMPROVE THE RISETIME OF A FEEDBACK AMPLIFIER
Kent Richard McCune (Ph.D. Thesis) 1969 121 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 70-7587

The terminal properties of a biased diode bridge are determined by experimental and analytical methods. These properties are then utilized to improve the risetime of a common type of feedback amplifier without degradation of other pulse response characteristics. The diode bridge network is treated as a two-terminal network with one of the bridge nodes being the input node and the opposite node the reference node. Bias current is supplied to and withdrawn from the two remaining opposite nodes. The volt-ampere characteristics, large-signal resistance, and incremental resistance between the input and reference nodes are reported. Computer programs are listed which solve the nonlinear equations describing the diode bridge network. Dissert. Abstr.

N71-22894 Denver Univ., Colo.
LINEAR SUBHARMONIC FILTERS
Donald Earl Cottrell (Ph.D. Thesis) 1969 116 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 70-9797

Periodically reverse-switched (PRS) capacitors or inductors in feedback networks, as well as networks without intentional feedback, are investigated. A linear subharmonic filter, which is a linear filter whose output response frequency is some subharmonic of the input signal frequency, results from placing a PRS capacitor in the feedback loop of an operational amplifier. Also, this filter may be realized on any general purpose digital computer. A mathematical description of the polyphase PRS capacitor and inductor is given which allows one to take into account a delay in the periodic switching time. Further, the polyphase (delay) concept, in conjunction with Laplace and Z-transforms, is extended to enhance the solution of a more complex problem dealing with time-division and demultiplexing systems. The desirability of using combinations of Laplace and Z-transforms with respect to PRS networks is indicated because their utilization results in a process which is linear and algebraic. Dissert. Abstr.

N71-22895 Purdue Univ., Lafayette, Ind.
AN INVESTIGATION OF INSTABILITIES IN THIN-FILM TRANSISTORS
Ronald Carl Hofer (Ph.D. Thesis) 1969 168 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 70-8903

The origins of short-term instabilities widely observed in the operating characteristics of thin-film transistors are investigated by measuring the electrical properties of the individual thin-film layers used in transistor fabrication. The investigation includes the development of thin-film fabrication procedures, the measurement of thin-film electrical properties, and the formulation of a model to describe the conduction characteristics observed in the insulating films. Investigation of a model for the bulk insulator containing two trap levels gives insight into the processes responsible for the transient decays observed in the insulator conduction characteristics. Delayed trapping of electrons in the insulator adjacent to the metal gate electrode near the drain region is proposed as the principal mechanism responsible for short-term drifts observed in thin-film transistor characteristics. Dissert. Abstr.

N71-22716 Arizona Univ., Tucson.
PERFORMANCE OF INTEGRATED ELECTRO-THERMAL CIRCUITS
Anthony Ray Fletcher (Ph.D. Thesis) 1969 160 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 70-8024

The basic elements of the general electro-thermal circuit are characterized in a manner similar to the two-port representation for electrical circuits. These basic elements are the sensor, heater, and the thermal structure which consists of the silicon chip mounted on a thermal insulator. These characteristics are utilized in the analysis of the temperature-stabilized substrate and the low-pass thermal filter. Small-signal models which include the effects of temperature variations are obtained and experimentally verified for the common integrated devices. These modes are used together with the characterizations of the sensor and heater elements in the analysis and evaluation of selected sensor and heater circuits. A method is also developed for the analysis of electrothermal circuits consisting of symmetrically arranged sensor and heater pairs operating in the differential mode. Dissert. Abstr.

N71-22745 California Univ., Los Angeles.
APERTURE SHARING FOR MULTIPLE UTILIZATION OF MICROWAVE ARRAY ANTENNA APERTURES
Stuart Rudin (Ph.D. Thesis) 1969 197 p
Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 70-8194

This technique for enhanced utilization of an aperture by multiple utilization of the available space appears to be feasible if the variation in driving point admittance of the radiating elements is compensated. In applications where the availability of aperture space is limited, the additional complexity of the system entailed in this technique may be warranted. Dissert. Abstr.

N71-22764 California Univ., Los Angeles.
SOLID INTERFACE STUDIES BY PHOTOELECTRIC TECHNIQUE
Seiki Ogura (Ph.D. Thesis) 1969 155 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 70-8184

Solid state interfaces of metal-insulator-semiconductor (MIS) structures are studied by photoelectric technique. The interface barrier height and the built-in voltage in the insulator layer of MIS structure are measured. Silicon dioxide, chemically grown nitride, and sputtered Al_2O_3 are used as the insulator. The effect of ion migration was studied by subjecting the structure to bias heat treatment. The band energy diagram for MIS structure is constructed both before and after B.H. treatment. The electric potential of MIS structure for arbitrary ion distribution is theoretically calculated and compared with the experimental result. After the photoelectric threshold is reduced by bias heat treatment, structure is observed in the photoelectric yield curve and, this is shown to be due to band to band transitions in silicon. Dissert. Abstr.

N71-22776*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MATCHED FILTERS FOR BINARY SIGNALS
S. Zohar *In its* The Deep Space Network, Vol. 1 15 Feb. 1971 p 52–62 refs (See N71-22766 11-30)
Avail: NTIS CSCL 09E

Matched filters for the optimal high speed detection of

binary signals are designed and their performance as a function of their complexity is explored. The range of filters designed extends from a 2 element filter whose performance is about 0.7 db below the ideal filter, up to a 20 element filter with a degradation of about 0.1 db. Author

N71-22777*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DIGITAL MODULATOR
R. Winkelstein *In its* The Deep Space Network, Vol. 1 15 Feb. 1971 p 63 - 65 (See N71-22766 11-30)
Avail: NTIS CSCL 09E

The design, construction, and installation of a digital modulator at DSS 14 is described. This device reshapes the digital modulating waveform generated at DSS 13 and received over the microwave link at DSS 14. The digital modulator output is an accurately adjustable 2 level waveform used to biphase-modulate the transmitter frequency. During precalibration setup, the digital modulator provides selectable frequency square waves used in correctly adjusting the waveform amplitude to obtain carrier suppression greater than 40 db. The capability that this technique provides was demonstrated in planetary radar experiments. By this method, one station's processor can be used to generate commands to be sent to a spacecraft from another station at the same complex, thus increasing the reliability of the DSN command system. Author

N71-22796* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
DIODE AND PROTECTION FUSE UNIT Patent
Keith H. Jenkins, inventor (to NASA) Issued 5 Sep. 1967 (Filed 5 Mar. 1965) 4 p Cl. 317-9
(NASA-Case-XKS-03381; US-Patent-3,340,430;
US-Patent-Appl-SN-437611) Avail: US Patent Office CSCL 09A

A unit combining a diode, fuse, and blown indicator into a single electrical circuit component is described. The unit includes an elongated tube fabricated from a transparent heat resistant material. Electrically conductive end caps close the tube and layers of opaque material coat the interior one third the length of the tube from each of its ends. The diode and fuse wire are secured to the respective end caps with a spring and indicator providing an electrical connection between them. The indicator is normally hidden behind the opaque material. If the fuse wire melts due to an excess of electrical current, the spring moves the indicator element to the transparent portion of the tube. Drawings are included. Official Gazette of the U.S. Patent Office

N71-22888* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
OMNIDIRECTIONAL MICROWAVE SPACECRAFT ANTENNA Patent
William F. Croswell and Melvin C. Gilreath, inventors (to NASA) Issued 12 Mar. 1968 (Filed 15 Mar. 1965) 4 p Cl. 343-708
(NASA-Case-XLA-03114; US-Patent-3,373,430;
US-Patent-Appl-SN-440039) Avail: US Patent Office CSCL 09E

A microwave omnidirectional antenna is described for use on a spacecraft. The antenna is a biconical horn placed between segments of the spacecraft. The antenna halves are connected by wedge-shaped scattering obstacles which offer minimum interference to a wave, and re-radiate obstructed portions of the wave. Official Gazette of the U.S. Patent Office

N71-22985* Spaco, Inc., Huntsville, Ala.
SIGHT SWITCH USING AN INFRARED SOURCE AND SENSOR Patent
Charles L. Nork, inventor (to NASA) Issued 23 Apr. 1968 (Filed 1 Mar. 1966) 4 p Cl. 250-83.3 Sponsored by NASA
(NASA-Case-XMF-03934; US-Patent-3,379,885;
US-Patent-Appl-SN-530958) Avail: US Patent Office CSCL 09A

A control switch consisting of an infrared source and an infrared sensor mounted on a frame beside the wearer's eye is described. The device senses the level of reflected light from the corner of the wearer's eye. When the wearer rotates his eyeball by looking toward the light source, the level of reflected light changes and a switching action occurs.
Official Gazette of the U.S. Patent Office

N71-22987* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ARC ELECTRODE OF GRAPHITE WITH BALL TIP Patent
William A. Gordon, inventor (to NASA) Issued 6 Aug. 1968 (Filed 21 Mar. 1966) 4 p Cl. 313-352
(NASA-Case-XLE-04788; US-Patent-3,396,303;
US-Patent-Appl-SN-537617) Avail: US Patent Office CSCL 09E

An arc source for emission spectroscopic analyses is described in which the cathode electrode comprises a graphite post having a globular tantalum tip. Official Gazette of the U.S. Patent Office

N71-22988* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ROTARY BEAD DROPPER AND SELECTOR FOR TESTING MICROMETEORITE DETECTORS Patent
Luc Secretan, inventor (to NASA) Issued 7 May 1968 (Filed 30 Aug. 1965) 9 p Cl. 73-1
(NASA-Case-XGS-03304; US-Patent-3,381,517;
US-Patent-Appl-SN-483886) Avail: US Patent Office CSCL 09E

An apparatus and method are described for calibrating a micrometeorite transducer detector by accurately dispensing a plurality of small, spherical beads at a predetermined rate. A bead dropper is moveably attached to a stationary support member; drive is provided for moving the bead dropper in a spiral path with respect to the transducer detector. An electrical output from the detector is applied to a display which records the impact of the individual beads. Official Gazette of the U.S. Patent Office

N71-22999* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SELF-CALIBRATING DISPLACEMENT TRANSDUCER Patent
Royce L. McKinney, inventor (to NASA) Issued 23 Jan. 1968 (Filed 6 Sep. 1963) 3 p Cl. 88-14
(NASA-Case-XLA-00781; US-Patent-3,364,813;
US-Patent-Appl-SN-307271) Avail: US Patent Office CSCL 09E

A self-calibrating transducer for measuring the magnitude and frequency of displacement of a body is described. The displacement transducer consists of a light source which produces a narrow beam of light, a reflecting surface attached to the body whose displacement is to be measured, a transparent medium with nontransparent, parallel, uniformly spaced lines, a variable density optical filter, a photoelectric detector and a recorder. The action of the transducer is to measure the displacement of a body along a straight line in one embodiment and to measure the angular displacement in the second embodiment.
Official Gazette of the U.S. Patent Office

N71-23015* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COMPLEMENTARY REGENERATIVE SWITCH Patent
Leonard L. Kleinberg, inventor (to NASA) Issued 19 Mar. 1968 (Filed 28 Sep. 1965) 3 p Cl. 307-288
(NASA-Case-XGS-02751; US-Patent-3,374,366;
US-Patent-Appl-SN-491059) Avail: US Patent Office CSCL 09A

A fast acting transistorized switch circuit is considered which incorporates a complementary pnp-npn configuration employing both positive and negative feedback. Upon the application of a positive input pulse to the input terminal, the positive feedback

overrides and regeneratively drives a transistor into saturation. Upon the removal of the positive input pulse, the negative feedback overrides and drives both transistors into the off condition in which state the circuit draws no power.

Official Gazette of the U.S. Patent Office

N71-23021* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

VIBRATING ELEMENT ELECTROMETER WITH OUTPUT SIGNAL MAGNIFIED OVER INPUT SIGNAL BY A FUNCTION OF THE MECHANICAL Q OF THE VIBRATING ELEMENT Patent

John Dimeff and Grant W. Coon, inventors (to NASA) Issued 21 May 1968 (Filed 17 May 1965) 10 p Cl. 324-120 (NASA-Case-XAC-02807; US-Patent-3,384,820; US-Patent-Appl-SN-456581) Avail: US Patent Office CSCL 09A

A vibrating element electrometer is described in which a vibratory element is disposed between fixed forcing and detecting plates. The vibrating element is electrostatically driven by a voltage containing an alternating voltage at the resonant frequency of the element in quadrature with the element's displacement, and the DC input voltage. With such an input applied to the forcing plate, the vibratory element vibrates at its resonant frequency. The motion of the vibrating element is magnified by the mechanical input current of the element from which the output signal at the detecting plate is magnified over the DC input by a fraction of the mechanical input current of the vibratory element to provide the arrangement with high conversion gain. Official Gazette of the U.S. Patent Office

N71-23027* Radio Corp. of America, Princeton, N.J.

SIMPLE METHOD OF MAKING PHOTOVOLTAIC JUNCTIONS Patent

Sidney G. Ellis, inventor (to NASA) Issued 12 Sep. 1967 (Filed 8 Mar. 1965) 3 p Cl. 29-572 Sponsored by NASA (NASA-Case-XNP-01960; US-Patent-3,340,599; US-Patent-Appl-SN-438135) Avail: US Patent Office CSCL 09A

An improved method is described for preparing gallium arsenide solar cells by the deposition of an inversion layer at its surface. The method can be performed at relatively low temperature and is simple to control. The method includes depositing a relatively thin, transparent, conductive layer of cuprous iodide on a relatively thin n-type polycrystalline layer previously deposited on a conducting substrate, and heating the cuprous iodide layer with iodine vapor to lower its resistance. Official Gazette of the U.S. Patent Office

N71-23097* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

CIRCULATOR HAVING QUARTER WAVELENGTH RESONANT POST AND PARAMETRIC AMPLIFIER CIRCUITS UTILIZING THE SAME Patent

Robert C. Clauss, inventor (to NASA) Issued 22 Aug. 1967 (Filed 15 Mar. 1965) 4 p Cl. 330-61 Sponsored by NASA (NASA-Case-XNP-02140; US-Patent-3,337,812; US-Patent-Appl-SN-440036) Avail: US Patent Office CSCL 09E

Improvements in electromagnetic wave transmission line circulators and application to electronic equipment are discussed. Principal improvement lies in the reduction in size of the circulator which permits its use with cascaded maser amplifiers which are cryogenically cooled. The circulator also finds use in parametric or tunnel diode amplifiers. Official Gazette of the U.S. Patent Office

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see specific Physics categories.

N71-21861 Ohio State Univ., Columbus.

BASIS TRANSFORMATION, LEAST SQUARE, AND CHARACTERISTIC MODE TECHNIQUES FOR THIN-WIRE SCATTERING ANALYSIS

Richard Harold Turpin (Ph.D. Thesis) 1969 166 p Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 70-6900

A numerical basis transformation technique is described which may be applied, in conjunction with point-matching methods, to obtain least square solutions of electromagnetic scattering by thin wires. It is shown that reductions in both computer solution time and computer storage requirements result. The technique is demonstrated by its application, along with piecewise uniform methods, to the solution of scattering by circular and elliptical loops, straight wires and open circular arcs. A computational technique is developed for determining certain modes which are useful for the solution of scattering and radiation problems. The basis transformation, least square, and mode-finding techniques are combined to compute characteristic mode current distributions of circular and elliptical loops, straight wires, circular arcs, and helices. In addition to the above topics, expressions are derived for the backscattering and tumble average backscattering cross sections of an object for arbitrary transmitter and receiver polarizations.

Dissert. Abstr.

N71-21946 Ohio State Univ., Columbus.

SYNTHESIS OF SHAPED-BEAM RADIATION PATTERNS

Warren Lee Stutzman (Ph.D. Thesis) 1969 311 p Avail: Univ. Microfilms: HC $14.20/Microfilm $4.00 Order No. 70-6892

Methods for shaping an antenna far-field radiation pattern when the antenna is representable either in part or in whole by a linear current distribution model were studied. Major emphasis is on shaping the mainbeam region to some desired shape while maintaining low sidelobes and a narrow width of the transition region between the sidelobe and mainbeam regions. For line sources and uniformly spaced arrays, the iterative sampling method is introduced, offering variability of design accuracy over pattern space with simplicity in its application. Two methods were used for shaped-beam nonuniformly spaced arrays, both approximating a continuous current distribution which corresponds to some desired pattern. The current sampling method involves judicious sampling of a current distribution which has zeros or deep nulls. The Gaussian quadrature method involves an integral approximation of the radiation integral. Dissert. Abstr.

N71-21947 Columbia Univ., New York.

APPLICATION OF METRIC GEOMETRY TO RESISTIVE NETWORKS AND n-PORTS

Gerald Emil Subak-Sharpe (Ph.D. Thesis) 1969 231 p Avail: Univ. Microfilms: HC $10.60/Microfilm $3.00 Order No. 70-7076

It is shown that any $(m+1)$-terminal positive resistive network forms an mth-order metric space Sm, whose characteristic is completely defined by the main theorem stated in this work. A metric transformation transforms Sm into the mth-order distance space, which is congruently imbeddable in m-dimensional Euclidean space Em. As a consequence, any $(m+1)$-terminal positive resistive network may be considered to form an mth-order simplex or geometrical figure in Em. This figure was shown to have all its first and higher-order angles acute and was called hyperacute-angled. As a consequence, problems on resistive networks, particularly on resistive n-ports, are equivalent to geometric problems on acute-angled simplexes imbeddable in multidimensional Euclidean space. All the knowledge on Euclidean spaces may therefore be utilized in the solution of the resistive n-port problem.

Dissert. Abstr.

N71-22021 Missouri Univ., Columbia.
ANALYSIS AND DETECTION OF FAULT TRANSIENTS IN POWER SYSTEMS
Kanaiyalal Ramanlal Shah (Ph.D. Thesis) 1969 77 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 70-6629

The design and operation of power systems to withstand disturbances without ensuing failure of the entire power system are considered. In analyzing the performance of protective devices capable of operating within the first cycle after the inception of faults, the transient waveforms for evaluating the conditions of power systems are determined. It is shown how instantaneous symmetrical components can be used in mathematically analyzing the complete transient response of both lumped and distributed parameter three phase, well transposed transmission lines under various shunt fault conditions. The results thus obtained are in agreement with previous published literature for lumped parameter representation. Dissert. Abstr.

N71-22064# Joint Publications Research Service, Washington, D.C.
IDEAS AND METHODS OF CYBERNETICS: PROCEDURAL BASE FOR DEVELOPMENT OF INDUSTRIAL INDICATING DEVICES
S. K. Bordakov *In its* Atmospheric Studies at Chem. Enterprises 9 Mar. 1971 p 131–152 refs (See N71-22055 11-13)
Avail: NTIS

Applications are discussed of systems analysis in the cybernetic simulation of automatic monitoring and sampling systems for continuously measuring industrial pollution levels. Feedback control, information processes, control system structural elements, and simulation model concepts are discussed. E.C.

N71-22105 Newark Coll. of Engineering, N.J.
DESIGN OF LINEAR CONTROL SYSTEMS WITH DISTRIBUTED PARAMETER ELEMENTS BY PARAMETER PLANE TECHNIQUES
Murray Weinberg (Ph.D. Thesis) 1969 263 p
Avail: Univ. Microfilms: HC $11.95/Microfilm $3.40 Order No. 70-4446

The advantages of utilizing this technique are that results can be obtained as two system parameters are varied simultaneously and higher order systems can be treated as easily as low order ones. Investigation of the mapping of real roots resulted in the derivation of a theorem which relates the number of real roots of the characteristic equation when parameters specify a given point in the parameter plane with the number of tangents which can be drawn from the operating point to certain segments of the zeta equals + or − 1 contours. Dissert. Abstr.

N71-22106 Columbia Univ., New York.
UNIVERSAL STRUCTURES WITH UNIFORM INTERCONNECTION PATTERNS FOR SYNCHRONOUS SEQUENTIAL CIRCUITS
Thomas Frederick Arnold (Ph.D. Thesis) 1969 151 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 70-6933

The problem considered is that of showing the existence of a basic circuit structure which has the following properties: (a) Any n-input synchronous sequential circuit can be realized by making small modifications to the basic circuit structure. (b) The basic circuit structure is composed of only one type (or a small number of types) of module. (c) The modules in the basic circuit structure are interconnected in a uniform manner. It is shown that such universal structures do exist, and that there are effective synthesis techniques for realizing a given machine with these structures. It is also shown that universal structures exist which have the above properties plus the following additional property: (d) The fan-in to every cell and the fan-out of every signal, including the input signals, are bounded by a constant. General properties of universal structures with uniform interconnection patterns are also considered. Dissert. Abstr.

N71-22141 Michigan Univ., Ann Arbor.
COUPLING ANALYSIS OF A LOADED AND UNLOADED PAIR OF RECTANGULAR WAVEGUIDE CAVITIES OPENING IN AN INFINITELY CONDUCTING GROUND PLANE
Medhat Ahmed Helmy Ibrahim (Ph.D. Thesis) 1969 161 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 70-4107

The coupling between two loaded rectangular waveguides opening in an infinite conducting ground plane has been investigated. The slots are equal in size and placed so as to have the broadsides parallel. The analysis is made in two steps: (1) the coupling between the apertures is derived; and the effect of the backing cavities on the coupling is determined. The reaction concept, a form of the variational technique, was used in the analysis. This method helped to simplify the mathematical work and provided very reasonable results. Substantial experimental work on the behavior of coupling versus frequency and coupling versus slot separation was performed. Dissert. Abstr.

N71-22150 California Univ., Berkeley.
CHARGE TRANSPORT AND STORAGE IN METAL NITRIDE OXIDE SILICON (MNOS) STRUCTURES AND ITS MEMORY APPLICATIONS
Dou Frohman-Bentchkowsky (Ph.D. Thesis) 1969 70 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 70-6105

A simple physical model that predicts charge accumulation at the dielectric interface of MNOS structures is proposed and verified experimentally. The model is based on the presence of steady-state current flow in the dielectric structure. Extensive investigation of charge transport and storage in MNOS structures leads to an understanding of the physical mechanisms underlying device operation, allowing optimization of device performance of digital storage applications. To demonstrate feasibility of large scale integrated MNOS storage arrays, a 9-bit word organized MNOS memory was fabricated. Dissert. Abstr.

N71-22230*# California Univ., Berkeley. Electronics Research Lab.
INPUT-OUTPUT PROPERTIES OF LINEAR TIME-INVARIANT SYSTEMS
C. A. Desoer 2 Mar. 1971 8 p refs Submitted for publication
(Grants NGL-05-003-016; NSF GK-10656X)
(NASA-CR-117467) Avail: NTIS CSCL 09C

General results concerning linear time invariant systems are given. The parallelism that exists between the continuous time case and the discrete time case is emphasized. An n-input, n-output, and linear time invariant feedback system is considered. The open loop gain is specified by the $n \times n$ matrix transfer function G(s) in the continuous case and G(z) in the discrete time case. Author

N71-22546# Argonne National Lab., Ill.
TRAINING MANUAL FOR FABRICATION OF PRINTED CIRCUIT BOARDS
C. A. Nelson, T. W. Yannitell, and S. J. Rudnick Jul. 1970 28 p refs
(Contract W-31-109-eng-38)
(ANL-7725) Avail: NTIS

This manual describes the methods used for fabricating small lots of printed circuit boards. Detailed step by step procedures are given. The purpose of this manual is to train personnel in the use

of an existing printed circuit fabrication facility. Information on the construction of a new facility or on the selection of equipment for a new facility is not included. Artwork preparation is not discussed.
Author

N71-22547# Sandia Corp., Albuquerque, N.Mex.
NATURAL VIBRATIONS OF THE R(t)CL CIRCUIT [UEBER EIGENSCHWINGUNGEN DES R(T)CL-KREISES]
J. Haeusler 18 Jan. 1971 28 p refs Transl. into ENGLISH from Frequenz, v. 24, no. 3, 1970 p 71–77
(SC-T-71-3003) Avail: NTIS

It is demonstrated that complete and exact solutions of the natural oscillations can be given explicitly for the more descriptive and characteristic equation of the R(t)CL-circuit, in the case of differing types of resistance changes (variations). Author

N71-22658*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
OPTIMAL CONTROL USING IMBEDDING OF THE TERMINAL CONDITIONS
Raymond C. Montgomery Washington Apr. 1971 56 p refs
(NASA-TR-R-359; L-6913) Avail: NTIS CSCL 12A

Imbedding theory is used to construct solutions of autonomous optimal control problems with free termination time; this is accomplished by imbedding the trajectory optimization problem of interest in a continuous family of problems which are parameterized by terminal conditions. Necessary conditions are derived which determine the modifications in the control functions required when passing from the solution corresponding to one member of the family to that corresponding to another member when their terminal conditions differ infinitesimally. By continuously collapsing the terminal conditions of the family of problems onto those of the original problem while appropriately modifying the control function, the solution to the original optimization problem can be obtained. A problem is solved for finding the time optimal maneuvers for an airplane to maneuver in such a way that the target vehicle (assumed to be nonmaneuvering) is placed in a situation favorable to deployment of the airplane's armament. The solutions to this problem are composed of both singular and nonsingular subarcs of the trajectory. Thus, the utility of imbedding in solving singular optimal control problems is illustrated. Author

N71-22671 Washington Univ., Seattle.
COORDINATE REPRESENTATION AND STRUCTURAL INVARIANTS FOR MANY-VALUED SWITCHING FUNCTIONS
Christopher Allen (Ph.D. Thesis) 1969 121 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 70-8400

The geometric properties of nonbinary switching functions are studied. These functions are a direct generalization of the Boolean functions of binary logic and are capable of representing information in a much more compact form than their binary counterparts. The result is to expand the geometric representation to include switching functions having any number of truth values and arguments. Theorems which relate the logical operation of exclusive or to vector inner product for radix two and three, an algorithm which generates a set of basis vectors appropriate to computing the coordinates, and an efficient means of performing this computation are presented. Uniqueness is proven, experimental results are displayed and the reduction to the binary case is shown to indicate the consistency of the generalization. The method of computing coordinates used involves a simple matrix multiplication and is valid for many-valued functions of arbitrary radix.
Dissert. Abstr.

N71-22747 New York Univ., N.Y. School of Engineering and Science.
TRANSIENTS IN GUIDING STRUCTURES
Peter Pleshko (Ph.D. Thesis) 1969 215 p
Avail: Univ. Microfilms: HC $9.70/Microfilm $3.00 Order No. 70-9787

The calculation of the transient response was based on a network approach with a 1:1 correspondence between the equations of the system and the equations of the network. A computer program was written which gave a transient characterization of four different types of dispersion characteristics and also the transient response waveform. The stationary phase characteristics of two guiding structures were examined in detail experimentally and the agreement with the calculations found to be extremely good. In addition to the stationary phase characteristics of the guiding structures, precursors were also examined.
Dissert. Abstr.

N71-22961* Massachusetts Inst. of Tech., Cambridge, Mass.
POWER SUPPLY Patent
Manuel Kramer and Louis H. Martinage, inventors (to NASA) Issued 23 Jan. 1968 (Filed 4 Mar. 1966) 5 p Cl. 323-56 Sponsored by NASA
(NASA-Case-XMS-02159; US-Patent-3,365,657;
US-Patent-Appl-SN-534564) Avail: US Patent Office CSCL 09C

A power supply is described which automatically corrects the power factor of a reactive load, as seen by the power amplifying elements of a power amplifier. The circuit comprises an input transformer with an ac voltage source. The output terminals are connected to a pair of transistors connected for push-pull class B operation. The transistor outputs are connected to the input of a pair of output transformers. The transformers are connected across a variable reactance load. The output transformers further comprise control windings having a direct current source. E.C.

N71-22962* Space Technology Labs., Inc., Redondo Beach, Calif.
LINEAR ACCELERATOR FREQUENCY CONTROL SYSTEM Patent
Charles A. Gilkison, inventor (to NASA) Issued 30 Jan. 1968 (Filed 24 Oct. 1965) 6 p Cl. 328-233 Sponsored by NASA
(NASA-Case-XGS-05441; US-Patent-3,366,886;
US-Patent-Appl-SN-505321) Avail: US Patent Office CSCL 09C

A system is described for generating a signal wave having a frequency proportional to a measured physical phenomenon. The system is useful in controlling the frequency of an alternating voltage applied to a linear accelerator for charged particles. A counting and control apparatus is included for applying a correction signal for varying the period of the generated signal wave in response to variations in a control signal representing the measured physical phenomenon. Official Gazette of the U.S. Patent Office

N71-22988* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ADAPTIVE TRACKING NOTCH FILTER SYSTEM Patent
Michael T. Borelli, Harry J. Daniels, and Hans H. Hosenthien, inventors (to NASA) Issued 26 Mar. 1968 (Filed 17 Jun. 1965) 14 p Cl. 328-167
(NASA-Case-XMF-01892; US-Patent-3,375,451;
US-Patent-Appl-SN-464878) Avail: US Patent Office CSCL 09C

An adaptive notch filter is described which constructs a reversed phase noise signal utilizing modulation techniques, and then sums the constructed signal with the composite input signal so that the noise signal is cancelled.
Official Gazette of the U.S. Patent Office

N71-23029* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOLID STATE PULSE GENERATOR WITH CONSTANT OUTPUT WIDTH, FOR VARIABLE INPUT WIDTH, IN NANOSECOND RANGE Patent
Norman M. Garrahan, inventor (to NASA) Issued 14 May 1968 (Filed 21 Oct. 1965) 5 p Cl. 307-265

(NASA-Case-XGS-03427; US-Patent-3,383,524; US-Patent-Appl-SN-500446) Avail: US Patent Office CSCL 09C

An apparatus for the generation of fixed duration output electrical pulses from variable length input pulses is described. A constant current generator is used in conjunction with a pulse control circuit. The control circuit uses a diode connected in parallel with an inductor. Official Gazette of the U.S. Patent Office

N71-23033* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DRIVE CIRCUIT UTILIZING TWO CORES Patent
Lawrence J. Zottarelli, inventor (to NASA) Issued 11 Jun. 1968 (Filed 7 Jul. 1964) 4 p Cl. 340-174 Sponsored by NASA
(NASA-Case-XNP-01318; US-Patent-3,388,387; US-Patent-Appl-SN-380965) Avail: US Patent Office CSCL 09C

Improvements are discussed in a magnetic core circuit apparatus applicable in selection matrices for digital memories. The selection matrix develops unipolar output pulses, without the use of a diode, when the magnetic core is switched from a first to a second and back to a first state. E.C.

N71-23084* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
VARIABLE DURATION PULSE INTEGRATOR Patent
Arthur L. Newcomb, Jr., inventor (to NASA) Issued 30 Jan. 1968 (Filed 9 Oct. 1964) 5 p Cl. 332-1
(NASA-Case-XLA-01219; US-Patent-3,366,894; US-Patent-Appl-SN-402978) Avail: US Patent Office CSCL 09C

The variable duration pulse integrator receives an incoming pulse whose duration through appropriate circuitry is changed. An incoming pulse is also integrated and this pulse and the duration pulse are both applied to a limiter which limits the amplitude of an output fed to a first emitter follower and integrator and then to a second emitter follower to an output terminal. The pulse however before reaching the output terminal is fed back through an amplifier to the input of the second emitter follower. This circuitry smooths out of limits the ripple content of the DC output voltage. Official Gazette of the U.S. Patent Office

N71-23099* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
METHOD OF RESOLVING CLOCK SYNCHRONIZATION ERROR AND MEANS THEREFOR Patent
Carl W. Johnson and Warren L. Martin, inventors (to NASA) Issued 23 Apr. 1968 (Filed 17 May 1967) 6 p Cl. 343-6.5 Sponsored by NASA
(NASA-Case-XNP-08875; US-Patent-3,380,049; US-Patent-Appl-SN-640455) Avail: US Patent Office CSCL 09C

The method for resolving the synchronization error of clocks in a plurality of stations tracking a spacecraft or satellite is presented. It includes sources of high frequency signals, accurately counted in the stations between start pulses produced in the stations from clocks, independently synchronized to within several milliseconds, and stop pulses produced in response to a signal received from the spacecraft. The count in each station represents an accurate time interval. The difference between the measured intervals equals the time period related to the range difference between the stations and the spacecraft, a time period representing known system errors, and the clock synchronization error. Knowing the range differences and the system errors the clock synchronization error is easily computed. Official Gazette of the U.S. Patent Office

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N71-21979# Federal Aviation Administration, Washington, D.C. Office of Aviation Economics.
WASHINGTON NATIONAL AND DULLES INTERNATIONAL AIRPORT FORECASTS, FISCAL YEARS 1971–1982
Nov. 1970 51 p
Avail: NTIS

Forecasts for eight major traffic categories at both Washington National Airport and Dulles International Airport for fiscal years 1971 through 1982 are presented. These categories are passengers (air carrier and all others), cargo (express, freight and mail), and aircraft operations (air carrier, general aviation, and military). The study is a basis for planning the intermediate needs of the Bureau of National Capital Airports. It also supplies guidance for other Offices and Services of the Federal Aviation Administration which have a direct interest in the day-to-day operation of these two major commercial airports. These forecasts indicate probable aviation demand for the Washington Metropolitan Area. They do not imply that physical capacity to fully meet this demand is available and in being today. These projections provide a foundation on which airport engineers and regional airport planning officials can make their own specialized studies and recommendations on how best to meet this demand. Author

N71-21996*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
SELECTION OF LANDING AIRFIELDS FOR SHUTTLE ORBITERS WITH VARIOUS CROSSRANGES Landing and Recovery Division Internal Note
Jonny E. Ferguson 25 Sep. 1970 112 p refs
(NASA-TM-X-67080; MSC-02666) Avail: NTIS CSCL 01E

The findings and recommendations resulting from a study designed to select specific airfields to support landings of example space shuttle orbiters with various hypersonic crossranges are reported. The orbiter is a single unit vehicle similar to a large jet transport in size, appearance, and landing characteristics. The airfields were selected from those currently available in the free world. Based upon the analysis of all the generated data associated with these airfield selections, it is recommended that the shuttle orbiter should be designed for a hypersonic crossrange not less than 200 n. mi. to optimize the number of support airfields required and the duration of in-orbit waits required. It is also recommended that the orbiter be designed to land on runways of not more than 10,000 feet in length and with support capability for 100-psi tire pressure and an equivalent single-wheel load of about 50,000 lb. Consideration should be given to the cost of the number of airfields required, the cost of modifying the airfields as required, the in-orbit waits required, and the hypersonic crossrange desired in all shuttle program design efforts. Author

N71-22095# Oxford Univ. (England). Engineering Lab.
A STUDY OF FILM COOLING RELATED TO GAS TURBINES USING TRANSIENT TECHNIQUES
T. V. Jones and D. L. Schultz 1970 47 p refs Sponsored by Sci. Res. Council
(Rept-1121/70) Avail: NTIS

The usefulness of short duration flow facilities by testing the film and transpiration cooling techniques for turbine blading is demonstrated. The transient techniques for measuring heat transfer rates in short duration flows are described. Two short duration flow facilities, the shock tunnel and an isentropic light-piston tunnel are described. The theory for the light-piston tunnel and the results for a small test rig are given. Finally, the work is extended to cooling studies with full scale turbine blade cascades. ESRO

N71-22157# National Aerospace Lab., Tokyo (Japan).
ON THE ACCURACY OF THE MULTICOMPONENT TEST STAND

Shinichi Ishii, Akira Yamada, Nobuo Chinzei, Kenji Kudo, and Toyozo Hikichi Jul. 1970 13 p ref In JAPANESE; ENGLISH summary
(NAL-TR-203) Avail: NTIS

A solid rocket multicomponent test stand for research of secondary injection thrust vector control mechanism is described including the construction, calibration accuracy, and error analysis of the test stand. Both hysteresis and friction are eliminated through the use of flexure pivot attachments on each end of the load cells. Load cell coefficients that include the flexure stiffnesses can be obtained through in-place calibration. The error terms associated with deflection under load and normal and inverted pendulum effects can be virtually cancelled within structure by reacting the thrust with four load cells, two of which are in tension and two of which are in compression. The static vector deviation of the test stand was within an angle deviation of 2 minutes of arc and within a vecton location deviation of 0.05 mm, and the bulk of interaction of the test stand was found to be caused by the bending of flexures which were in compression. Author

N71-22158# Cornell Aeronautical Lab., Inc., Buffalo, N.Y. Aerodynamic Research Dept.
RESEARCH ON ADVANCED GASDYNAMIC TEST FACILITIES. PART 1: STUDIES OF THE ISENTROPIC COMPRESSION TUBE AS A MEANS FOR PRODUCING HYPERVELOCITY TEST FLOWS Final Technical Report, 1 Jul. 1966–30 Jun. 1970
Frank J. Stoddard Jan. 1970 77 p refs
(Contract AF 33(615)-5389)
(AD-717727; CAL-AD-2297-A-3-Pt-1; ARL-70-0235-Pt-1) Avail: NTIS CSCL 14/2

The report summarizes research conducted on the use of isentropic-compression techniques for producing hypervelocity test flows. The results of experiments in the pilot isentropic-compression tube are reported and compared with theoretical predictions. It is shown that the experimental results are, in general, in agreement with the theoretical performance predictions for both the isentropic-flow and the free-piston shock-tube mode of operation. Theoretical estimates of the performance of a large-scale high-pressure facility are given which indicate that such a facility would be extremely versatile and capable of performance far exceeding that of existing short-duration high-speed test facilities. The report provides a complete documentation of the research conducted including previously unpublished work recently completed. Author (GRA)

N71-22173# Harvard Univ., Boston, Mass. Air Cleaning Lab.
[SODIUM AEROSOL PROPERTIES AND FISSION GAS ADSORPTION BED EVALUATION] Semiannual Progress Report, 1 Mar.–31 Aug. 1970
M. W. First, D. W. Underhill, A. S. Goldin, H. Yusa, P. C. Reist et al Oct. 1970 83 p refs
(Contract AT(30-1)-841)
(NYO-841-23) Avail: NTIS

The experimental methods used and results obtained at the Harvard Air Cleaning Laboratory are described for the following studies: measurement of thermal conductivity of layers of elemental Na deposited on heat exchanger surfaces; behavior of I in Na systems; optical properties of Na aerosols; and evaluation of fission gas adsorption beds. In addition consultation services were provided to projects related to the fast flux test facility. NSA

N71-22281# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Inst. fuer Raumsimulation.
ANALYTICAL INVESTIGATION OF TEMPERATURE DISTRIBUTION ON A CONTINUOUSLY ROTATING AND REVERSING HOLLOW CYLINDER UNDER SPACE CONDITIONS [ANALYTISCHE UNTERSUCHUNG DES TEMPERATURVERLAUFS AUF EINEM KONTINUIERLICH ROTIERENDEN UND REVERSIERENDEN HOHLZYLINDER UNTER WELTRAUMBEDINGUNGEN]
Hans Peter Schmidt and Willi Hallmann Dec. 1970 106 p refs In GERMAN; ENGLISH summary
(DLR-FB-70-59) Avail: NTIS; ZLDI Munich: 28.80 DM

Temperature deviations on the surface of a hollow cylinder are demonstrated, arising when reversal rotation is compared with continuous rotation during space simulation tests. The influence of the divergent radiation is calculated and the solution of the boundary value problem of the second order is reduced to the integration of Green's function. The temperature distribution on the reversing hollow cylinder is also examined. Criteria for selecting the reversal parameters, speed in forward and backward direction as well as reversal position, are discussed in order to obtain a satisfying conformity between reversion and continuous rotation. Author (ESRO)

N71-22298# Brookhaven National Lab., Upton, N.Y.
ECONOMICAL BEAM TRANSPORT FOR UTILIZATION OF THE POST CONVERSION AGS
J. E. Allinger, G. T. Danby, J. W. Jackson, and L. W. Smith 8 Dec. 1970 70 p Sponsored by AEC
(BNL-15464) Avail: NTIS

Conclusions and recommendations from a study on the design and installation of a new external beam transport system to effectively utilize the forthcoming beam intensity gain (a factor of 10 gain) of the Brookhaven AGS are presented. Topics discussed include a review of some simple scaling laws on magnet sizes and strengths; some implications for optical properties due to variations of magnet strengths, lengths, and aperture sizes; cryogenic technology and beam transport; cost and performance criteria; power supply and facility costs; quadrupole magnet costs and parameters; dipole magnet costs and parameters; and parameter and cost curves. NSA

N71-22331# National Aeronautical Lab., Bangalore (India).
ANNUAL REPORT OF THE NATIONAL AERONAUTICAL LABORATORY, 1969–1970
1970 91 p refs
Avail: NTIS

Summaries of research activities are presented. The laboratory's major project was the design, fabrication, commissioning, and calibration of a 4-ft trisonic wind tunnel. Other projects reported include the following areas of research: (1) aerodynamics, (2) structural sciences, (3) materials science, (4) propulsion, (5) electronics, (6) instrumentation, (7) mathematical sciences, (8) pilot plants, and (9) technical aid and assistance. D.L.G.

N71-22430# Technion - Israel Inst. of Tech., Haifa. Aeronautical Research Center.
THE IIT 40 cm × 60 cm INTERMITTENT, SINGLE JACK, FLEXIBLE NOZZLE SUPERSONIC WIND TUNNEL CALIBRATION AT MACH NUMBERS 1.5 TO 3.0
I. Etsion, J. Rom, and M. Salomom Apr. 1970 22 p refs Presented at 33d Semiann. Meeting of the Supersonic Tunnel Assoc., El Segundo, Calif., 7–8 May 1970
(TAE-110) Avail: NTIS

A test program was conducted to calibrate the test region of a single jack, flexible nozzle supersonic wind tunnel. A general description of the wind tunnel as well as results of the calibration at nominal Mach numbers of 1.5, 2.0, 2.5 and 3.0 are presented. The maximum Mach number variation was + or − 0.01 along the centerline of the sidewall and also + or − 0.01 in the test cross section area for all these Mach numbers. Author

N71-22463# National Bureau of Standards, Washington, D.C.
PHOTOMETRIC CHARACTERISTICS OF SEMIFLUSH AIRPORT LIGHTS

A. C. Wall [1970] 57 p
(NBS-10121) Avail: NTIS

The intensity distribution characteristics of semiflush airport approach and runway lights are presented. As installed these lights project one-half or one inch above the pavement surface. The lights may be separated into two generic groups: (1) capsule-type lights using tubular halogen-cycle lamps with lens-type optical systems, and (2) prismatic-head lights using PAR-type sealed reflector lamps with their beam axes vertical, and with prisms to redirect the beams to near-horizontal directions. Intensity distribution data of at least one light of the principal sub types of each generic group are included. Author

N71-22476# National Aeronautical Lab., Bangalore (India).
WIND TUNNEL PRESSURE REGULATING SYSTEMS
S. Balakrishna Feb. 1970 27 p refs
(NAL-TN-22) Avail: NTIS

The design aspects of the flow control system are discussed with reference to wind tunnels at the National Aeronautical Laboratory, Bangalore. A system model is obtained and the effects of various disturbances and their effects on the regulating accuracy are discussed. Author

N71-22488# National Inst. for Telecommunications Research, Hartebeesthoek (South Africa). Deep Space Instrumentation Facility.
PIONEERS 6 AND 8 Mission Summary Report, 5 Oct. 1970–7 Feb. 1971
H. M. Bryant and O. Minter 1 Jan. 1971 18 p
(DSIF-51/OPS/16/1) Avail: NTIS

Reduced shift manpower for Pioneer operations is reported, with accompanying data loss. The operational equipment and systems are briefly discussed, including antenna, antenna pointing subsystem, TDH subsystem, RF subsystem, telemetry command processor, digital instrumentation system, analog recorders, and Pioneer ground operational equipment. Pioneer failures and anomalies are summarized in tabular form. J.A.M.

N71-22526*# National Aeronautics and Space Administration, Washington, D.C.
A REPORT ON THE CLOSING OF THE NASA ELECTRONICS RESEARCH CENTER, CAMBRIDGE, MASSACHUSETTS
Boyd C. Myers 1 Oct. 1970 284 p refs
(NASA-TM-X-67054) Avail: NTIS CSCL 14B

The procedures for closing a government facility are elucidated, using as an example the NASA Electronics Research Center. The closing activities are listed in chronological and categorical order, including public affairs, legislative affairs, loans to universities, equipment and real estate disposal, and financial management. The varied effects on personnel and research programs are also related. J.A.M.

N71-22554*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Environmental Sciences Div.
A HIGHER PERFORMANCE ELECTRIC ARC DRIVEN SHOCK TUBE
W. A. Menard *In its* JPL Quarterly Tech. Rev., Vol. 1, No. 1 Apr. 1971 p 17–28 refs (See N71-22551 11-30)
Copyright. Avail: NTIS HC$6.00/MF$0.95 CSCL 14B

The results of an experimental study made to improve the performance of electric arc driven shock tubes are presented. With only minor modifications to the driver, shock velocities have been increased by a factor of 3. The new driver has a conical internal design of small volume, and uses a light-weight diaphragm which disintegrates during the electrical discharge. Data obtained from a 15.2-cm-diameter driven tube, 11.3 m in length, show little shock wave attenuation in gases simulating the Jupiter and Saturn atmospheres. Shock velocities of 45 km/s with test times in excess of 4 microseconds have been attained. Because of the extended performance, the electric arc driven shock tube can be used to study many outer planet atmospheric entry problems. Author

N71-22590*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DEVELOPMENT OF A SIMULATOR FOR STUDYING SIMPLIFIED LUNAR ESCAPE SYSTEMS
George J. Hurt, Jr., David B. Middleton, and Marion A. Wise Washington Apr. 1971 46 p refs
(NASA-TN-D-6111; L-7364) Avail: NTIS CSCL 14B

A lunar-escape-system simulator was designed and fabricated to be used as a research tool to study problems related to lunar escape and simplified manual guidance and control. The design involved a two-man platform with instruments and controllers mounted on a strain-gage base. Most of the vehicle characteristics and control logic were contained in the computer program; thus a wide range of vehicles (including the lunar flying vehicles) and guidance and control systems could be studied. The computer program was compared with an independent computer program with good agreement. During checkout operations the subjects were able to adapt to the equipment with a minimum of training and instruction in the operation of the simulator. Author

N71-22593# Cornell Aeronautical Lab., Inc., Buffalo, N.Y. Aerodynamic Research Dept.
RESEARCH ON ADVANCED GASDYNAMIC TEST FACILITIES. PART 2: LASER-FLUID INTERACTION STUDIES Final Technical Report, 1 Jul. 1966–30 Jun. 1970
John W. Daiber, Ronald G. Rehm, and Herbert M. Thompson Wright-Patterson AFB, Ohio ARL Oct. 1970 41 p refs
(Contract AF 33(615)-5389)
(AD-717728; CAL-AD-2297-A-3-Pt-2; ARL-70-0236) Avail: NTIS CSCL 14/2

The report describes experimental and theoretical studies conducted on the application of lasers to aerodynamic facilities. The experimental program is concerned with the response of a gas to a high-intensity ruby laser beam. The primary diagnostic tools are high-speed streak cameras and x-ray emission monitors. Experiments were performed in both a spatially uniform gas and in a free-jet expansion. In the latter configuration, fast moving fronts of bright luminosity are propagated back into the high-density reservoir by the absorption of the laser energy. The theoretical effort was concerned with describing the types of fluid responses to laser energy addition through both analytical and numerical analysis. Author (GRA)

N71-22635 Rolls-Royce, Ltd., Bristol (England). Engine Div.
THE USE OF A GUN TUNNEL FOR HYPERSONIC INTAKE CALIBRATION
R. Hawkins and E. Carlton *In* AGARD New Exptl. Tech. in Propulsion and Energetics Res. Oct. 1970 p 211–240 refs (See N71-22626 11-12)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The use of a gun tunnel as a low temperature test facility for hypersonic intake research was studied with the techniques suitable for calibrating intakes for both supersonic and subsonic combustion ramjet engines. One of the major advantages of the gun tunnel is the ability to establish supersonic throat flow within the intake, without recourse to variable geometry. This, coupled with the fact that the flow duration is short (typically 30 to 100 milliseconds), has led to great simplification and economy in intake model construction. In the case of an intake for a supersonic combustion engine where the blockage of multitube rakes would be unacceptable, a high speed pitot traverse technique was successfully developed. For the more difficult case of the subsonic combustion intake, it is necessary to cover a range of back pressures up to

the critical value. This has been achieved by fitting a specified volume to the intake, in which the rate of pressure rise is slow enough to permit a transient calibration procedure to be adopted. Tests were made in a conventional wind tunnel facility to check the validity of the results obtained. Author

N71-22770*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DSN INHERENT ACCURACY PROJECT
T. W. Hamilton and D. W. Trask *In its* The Deep Space Network, Vol. 1 15 Feb. 1971 p 11-13 refs (See N71-22766 11-30)
Avail: NTIS CSCL 14B

The objectives and organization of the inherent accuracy project and technical work performed by the project are described. A summary is included of the effects of transmission media on radiometric data during the Mariner Mars 1969 mission. Author

N71-22790*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SFOF CONFIGURATION CONTROL
K. R. Carter *In its* The Deep Space Network, Vol. 1 15 Feb. 1971 p 122-123 (See N71-22766 11-30)
Avail: NTIS CSCL 14B

The need for and design of a Space Flight Operations Facility Configuration Control System based on the highly dynamic nature of the facility and the unique, critical requirements levied upon it by multiple and simultaneous flight projects supported by various functional organizations is described. Author

N71-22816# Israel Program for Scientific Translations, Ltd. Jerusalem.
ARCTIC INSTITUTE OF NORTH AMERICA
A. O. Shpaikher *In its* Probl. of the Arctic and the Antarctic 1970 p 118-128 (See N71-22801 11-13)
Copyright. Avail: NTIS HC$6.00/MF$0.95

The Arctic Institute of North America (AINA) was established in Canada in 1945. Its main tasks are studies of the natural conditions in the north, problems of economic development of the Arctic and its living conditions, and the influence of arctic regions on global physical, social, economic problems. The institute maintains relations with polar research organizations in other countries, collaborates with Canadian and American organizations engaged in arctic studies, and works in close cooperation with McGill University. A.L.

N71-22831# Israel Program for Scientific Translations, Ltd., Jerusalem.
SOME RESULTS OF INVESTIGATIONS INTO THE OPERATION OF AUTOMATIC RADIOMETEOROLOGICAL DRIFTING STATIONS IN THE ARCTIC
I. G. Moroz et al *In its* Probl. of the Arctic and the Antarctic 1970 p 254-258 refs (See N71-22801 11-13)
Copyright. Avail: NTIS HC$6.00/MF$0.95

The design, operation, and accuracy of the automatic radiometeorological drift stations (DARMS) used by the Soviets in the Arctic are described. As a result of these investigations, several recommendations are made for slight modifications to improve the accuracy and reliability of the DARMS. A.L.

N71-22875* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EXPOSURE SYSTEM FOR ANIMALS Patent
Phillip D. Quattrone and Robert W. Staley, inventors (to NASA) Issued 6 Feb. 1968 (Filed 26 Apr. 1966) 10 p Cl. 119-15
(NASA-Case-XAC-05333; US-Patent-3,367,308;
US-Patent-Appl-SN-546148) Avail: US Patent Office CSCL 14B

A method of exposing animals for studying toxicological aspects of artificial atmospheres is described which permits continuous monitoring of the exhalations, weighing, and cage cleaning without changing the atmospheric composition or pressure. A hermetically sealed capsule is connected to the gas source with an outlet to a vacuum system to which an analyzer is connected. An auxiliary capsule is provided with a transfer passway for weighing and cleaning. The animal is transferred to the auxilliary capsule which is then sealed off from the test capsule. F.O.S.

N71-23030* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MODEL LAUNCHER FOR WIND TUNNELS Patent
Harold P. Holway, inventor (to NASA) Issued 19 Sep. 1967 (Filed 2 Apr. 1965) 5 p Cl. 73-147 Sponsored by NASA
(NASA-Case-XNP-03578; US-Patent-3,342,066;
US-Patent-Appl-SN-445292) Avail: US Patent Office CSCL 14B

This invention is employed for studying the performance of a body in a high speed wind tunnel. A model launcher is positioned within the wind tunnel adjacent a viewing window. The model launcher includes a chamber and a piston movable within said chamber. The piston ends in a rod having an end whereupon the body or model can be supported for a launching. The piston is held from moving while gas under pressure is introduced into the chamber. When the piston is released, the gas moves the piston and the rod until the piston is snubbed, whereupon the model can continue its movement into the wind in the chamber, and its operation in flight is studied through the window. Official Gazette of the U.S. Patent Office

N71-23042* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
MULTIPLE ENVIRONMENT MATERIALS TEST CHAMBER HAVING A MULTIPLE PORT X-RAY TUBE FOR IRRADIATING A PLURALITY OF SAMPLES Patent
Robert L. Johnston Issued 5 Sep. 1967 (Filed 9 Dec. 1964) 8 p Cl. 250-52
(NASA-Case-XMS-02930; US-Patent-3,340,397;
US-Patent-Appl-SN-417253) Avail: US Patent Office CSCL 14B

The test chamber is described which utilizes a single source of X-rays at the center of the chamber housing having multiple outlets for exposing the materials to various environmental conditions. Testing and measuring equipment are mounted outside the chamber around the periphery. The materials to be tested are mounted within the chamber at the periphery with means provided to rotate each of the materials to a position whereby numerous tests may be performed to measure the progressive changes in the materials. Due to the rotational features, a minimum of testing equipent is necessary which may be permanently mounted around the periphery of the chamber so as to obviate the need for recalibration of the equipment. Official Gazette of the U.S. Patent Office

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N71-21909# Naval Postgraduate School, Monterey, Calif.
PRESSURE SIGNATURES OF A CYLINDRICAL BODY MOVING IN AQUEOUS SOLUTIONS OF POLY(ETHYLENE OXIDE)
Ray Cowden Witter (M.S. Thesis) Dec. 1970 47 p refs
(AD-717584) Avail: NTIS CSCL 20/4

A whirling arm apparatus was successfully developed and tested for investigating the pressure signatures of submerged bodies of length less than one foot. The pressure signature of a cylindrical body, nine inches long and one inch in diameter, moving

at constant velocities of 1.57, 1.84, and 2.36 m/s in aqueous solutions of poly(ethylene oxide) WSR-301 at concentrations of 0, 50, 100, and 200 wppm was investigated under laminar flow conditions; Reynolds numbers, based on length, were in the range from 360,000 to 540,000. A regular laminar flow pattern was investigated utilizing the body with a hemispherical bow and tapered stern, and a laminar flow pattern with forced fluid separation followed by reattachment was investigated by utilizing a squared-off bow and a tapered stern. A barium titanite crystal hydrophone was used as the sensor. No apparent difference in the pressure signature was found which could be attributed to the addition of the polymer into solution. Author (GRA)

N71-21919 Virginia Polytechnic Inst., Blacksburg.
AN APPROXIMATE SOLUTION TO THE NONEQUILIBRIUM FLOW IN THE INVISCID SHOCK LAYER ABOUT A VEHICLE IN HYPERSONIC FLIGHT IN AN ARBITRARY ATMOSPHERE
William Lyman Grose (Ph.D. Thesis) 1969 213 p
Avail: Univ. Microfilms: HC $9.70/Microfilm $3.00 Order No. 70-5352

An inverse solution is presented based upon a thin shock layer approximation and has the advantage of being applicable to both subsonic and supersonic regions of the shock layer. The relative simplicity of the method makes it ideally suited for programming on a digital computer with a significant reduction in storage capacity and computing time required by other more exact methods. A digital computer program written in Fortran language is presented that permits an arbitrary gas mixture to be employed in the solution. The effects of vibration, dissociation, recombination, electronic excitation and ionization are included in the program. Comparison of both equilibrium and nonequilibrium solutions for an air mixture obtained by the present method is made with solutions obtained by two different more exact numerical methods. Additional nonequilibrium cases are presented for entry of spherical-nose cones into representative Venusian and Martian atmospheres. Dissert. Abstr.

N71-21968# Lockheed Missiles and Space Co., Palo Alto, Calif.
FORMATION OF A HANGING COMPRESSION SHOCK IN THE FLOW AROUND A PROFILE WITH A BREAK IN THE GENERATOR
E. G. Shifrin 1970 13 p refs Transl. into ENGLISH from Prikl. Mat. Mekh. (USSR), v. 34, no. 6, 1970 p 1159–1167
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The necessity for the origination of a hanging shock in the flow around bodies with a break in the generator is established analytically, as are its properties in a plane ideal gas flow. The case of low free-stream supersonic velocity is investigated when changes in entropy at the shock can be neglected; the possibility of a transonic approximation of the shock polar and its intersecting characteristics is also utilized here. Author

N71-21970# Columbia Univ., New York. Lubrication Research Lab.
ON THE FLOW BETWEEN TWO LONG ECCENTRIC CYLINDERS
Des R. Sood and H. G. Elrod Dec. 1970 52 p refs
(Contracts N00014-67-A-0108-0021; Nonr-4259(14))
(AD-717366; Rept-17) Avail: NTIS CSCL 20/4

The fluid inertia effects in the lubricating air film of high-speed tape transport systems have yet to be understood. To cope theoretically with the attendant problems, a computational procedure was developed to solve the Navier-Stokes equations of fluid motion for an incompressible fluid in a doubly-connected region. As a test case, the new procedure was applied to the flow in the annular region between two long eccentric cylinders, one of which is rotating. Excellent agreement is obtained with exact analytical results for the problem when inertia can be neglected. The numerical results are then extended to cover a wide range of operating parameters, with considerable assurance that the predictions so-obtained are accurate. Author (GRA)

N71-21988# Oxford Univ. (England). Engineering Lab.
ACOUSTIC RESONANCE IN CASCADES
R. E. Franklin Feb. 1971 16 p refs
(Rept-1007/71) Avail: NTIS

The problem of the excitation of acoustic resonances in cascades by the pressure fields of vortices shed at the trailing edges of the blades is reviewed. It is shown that the resonant frequencies may be estimated directly. The mechanism of the resonance is clarified. Parker's result served as a check on the accuracy of the method. Finally it is concluded that the calculation may easily be extended to the three dimensional cases. ESRO

N71-21995*# Pratt and Whitney Aircraft, West Palm Beach, Fla. Research and Development Center.
SINGLE STAGE EXPERIMENTAL EVALUATION OF COMPRESSOR BLADING WITH SLOTS AND WALL FLOW FENCES
R. W. Rockenbach and J. A. Brent 1 Apr. 1971 174 p refs
(Contract NAS3-10481)
(NASA-CR-72635; PWA-FR-3597) Avail: NTIS CSCL 20D

A highly loaded 0.8 hub-tip ratio single stage axial flow compressor was tested with two rows of slots in both the rotor and stator blades and with wall mounted intrablade row flow fences. These devices were intended to reduce the migration of wall boundary layer flow onto the blade surfaces and to prevent flow separation on the blade suction surfaces. The devices were found to be ineffective in achieving this goal and the poor performance of the stage was largely a result of stall in the wall region. It was concluded that the latter mechanism is limiting the permissible loading and, therefore, that future means of increasing permissible loading be concentrated on the wall stall problem. Author

N71-22024*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LATERAL SLOSHING IN OBLATE SPHEROIDAL TANKS UNDER REDUCED- AND NORMAL-GRAVITY CONDITIONS
Thom A. Coney and Jack Salzman Washington Mar. 1971 19 p refs
(NASA-TN-D-6250; E-5842) Avail: NTIS CSCL 20D

An experiment was conducted to measure the natural lateral sloshing frequency of liquids in oblate spheroidal tanks. The eccentricities of the tanks used were 0, 0.68, and 0.8. The liquids chosen exhibited 0 deg static contact angles on the container walls. Tests were conducted under both reduced- and normal-gravity conditions. Resulting Bond numbers ranged from 5 to 927. The data were compared with low and high Bond number theory and with the results of previous studies. Author

N71-22048# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
A STUDY OF THE INTERACTION OF A LAMINAR HYPERSONIC BOUNDARY LAYER WITH A CORNER EXPANSION WAVE
A. K. Lo Sep. 1970 55 p refs Sponsored by Natl. Res. Council of Can.
(UTIAS-157) Avail: NTIS

This thesis describes a study of the application of Dorodnitsyn's Method of integral relations and some related techniques belonging to the method of weighted residuals to hypersonic laminar boundary layer problems. Numerical Galerkin-Doronitsyn single strip solutions to the viscous-inviscid equations are presented for small turning angles, corner radii comparable to the boundary layer thickness and

distances downstream to the point where transverse pressure gradients become negligible. The results show small upstream influence, extended downstream boundary layer-expansion wave interaction, significant pressure differences across the boundary layer, and weak overexpansion of the pressure at the edge of the layer. They also show a peak in heat transfer and skin friction at the corner, and suggest that the extent of the interaction would not be detected by measuring wall pressure. Comparisons of the methods are also made for boundary layer obeying the classical Prandtl equations. Author

N71-22087# Politecnico di Torino (Italy). Istituto di Meccanica Applicata Aerodinamica e Gasdinamica.

LOW PRANDTL NUMBER STAGNATION HEAT FLUX CALCULATIONS FOR A BLUNT AXISYMMETRIC BODY IN HYPERSONIC FLOW

Aldo Muggia Jul. 1970 10 p refs

(Contract EOOAR-0049-68)

(AD-717418; AFOSR-70-3009TR; TN-63; SR-9) Avail: NTIS CSCL 20/4

Calculations are performed of the enthalpy behaviour and of the wall heat flux in the stagnation region past a blunt axisymmetric body in hypersonic axial flow. The case of high-free-steam Mach number and consequently high temperature and low Prandtl number in the stagnation region is considered. By supposing equilibrium flow, two numerical examples are presented for Peclet number. Author (GRA)

N71-22096# Naval Postgraduate School, Monterey, Calif.

DRAG OF FREE-FALLING SPHERES IN WATER FOR REYNOLDS NUMBERS NEAR CRITICAL

George Fred Nolan (M.S. Thesis) Sep. 1970 88 p refs

(AD-717492) Avail: NTIS CSCL 20/4

Drag coefficients of free-falling spheres in water were determined in a 12-ft diameter tank. Nine spheres with weights ranging from 361 grams to 4587 grams were released from rest and their speeds measured 19.5 feet below the release point using orthonormal cinematography. The region on both sides of the critical Reynolds number was covered with Reynolds numbers ranging from 100,000 to 700,000. Spheres with Reynolds numbers less than the critical values displayed little scatter in their terminal velocities. The same was true for the heaviest sphere. However, spheres with Reynolds number immediately above the critical value frequently deviated from the normal trajectory and their speeds showed scatter as great as 20%. A plot of drag coefficient versus Reynolds number shows that free-falling spheres essentially conform to the wind tunnel results; the critical Reynolds number is unchanged and the drag coefficients differ no more than 20%, always being higher for the free-fall case. Author (GRA)

N71-22124# Politecnico di Torino (Italy). Istituto di Meccanica Applicata Aerodinamica e Gasdinamica.

RESEARCHES ON HYPERSONIC AND RADIATING FLOWS, THERMAL SHOCK, RAREFIED GASDYNAMICS Final Scientific Report, 1 Feb. 1968 – 31 Jan. 1970

Carlo Ferrari Jul. 1970 9 p refs

(Contract EOOAR-0049-68

(AD-717419; AFOSR-70-3012TR) Avail: NTIS CSCL 20/4

The researches are concerned with the following subjects: radiating gas flows; rarefied gasdynamics; thermal shock; laminar boundary layer; high temperature, high speed gases; hypersonic flow about blunt bodies. GRA

N71-22138# Naval Postgraduate School, Monterey, Calif.

MEASURED AND PREDICTED PRESSURE DROPS IN TWO-PHASE AIR WATER FLOWS

John Meredith Bonds (M.S. Thesis) Sep. 1970 110 p refs

(AD-717580) Avail: NTIS CSCL 20/4

Two-phase, air-water flow is studied in a horizontal pipe. Water injection methods are compared to determine an efficient means of attaining fully developed homogeneous flow. Wall shear forces are measured directly through flexures attached to a floating test section. The pressure drops are compared to those predicted by the Lockhart-Martinelli and Chenoweth-Martin correlation schemes. A computer program is presented for data reduction. For the flow rates investigated it is concluded that the Lockhart-Martinelli correlation gives better results than does the Chenoweth-Martin scheme providing one knows the existing flow pattern. A new method is suggested for predicting the transition between the annular and mist flow regimes. Author (GRA)

N71-22139# Stevens Inst. of Tech., Hoboken, N.J. Davidson Lab.

INTERACTION BETWEEN GRAVITY WAVES AND FINITE TURBULENT FLOW FIELDS Final Report

Daniel Savitsky Jan. 1971 88 p refs

(Contract Nonr-263(36))

(AD-717627; SIT-DL-71-1469) Avail: NTIS CSCL 8/3

A laboratory study of the interaction of deep water gravity waves progressing into a turbulent flow field produced by a finite width grid towed in a wide tank showed wave height attenuations of nearly 90% in the grid wake and wave height amplifications of nearly 75% in the still water outside the wake. The transverse gradient of longitudinal flow in the wake was predominantly responsible for the large wave deformations and precluded an evaluation of direct turbulence effects. A simple, analytical solution using wave refraction, defraction and superposition concepts is developed which qualitatively reproduces the measured results. Author (GRA)

N71-22156# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE EFFECT OF EDGE BLUNTNESS OF A FLAT PLATE ON HEAT TRANSFER IN A SUPERSONIC FLOW

L. V. Kozlov 2 Dec. 1970 15 p refs Transl. into ENGLISH from the book "Issled. Teploobmena v Potokakh Zhidkosti i Gaza" Moscow, Izd-Vo Mashinostr., 1965 p 103 – 109

(AD-717825; FTD-MT-24-274-70) Avail: NTIS CSCL 20/4

The effect of edge bluntness of a flat plate on heat transfer is experimentally investigated in the region where anisotropic conditions do not exist on the limit of the boundary layer. The experiments were carried out by means of a wind tunnel having a 110 x 110 mm test section with nozzle velocities in the Mach range from 2 to 4 M. Heat transfer was evaluated on a flat plate with cylindrical bluntness in a range of a given relative bluntness. The dependence of the nondimensional heat-transfer coefficient on the Reynolds number is illustrated in a graph. The data obtained with a blunt-edged flat plate are compared with those obtained on a sharp-edged flat plate. The distribution of local heat fluxes on both plates is presented in graphical form and shows that at given large ratios the local value of the heat flux on a blunt-edged plate is always smaller than on a sharp-edged plate, but in a given vicinity the boundary layer builds up faster. An analysis of the results shows that the effect of bluntness increases with the Mach number. Author (GRA)

N71-22169# Catholic Univ. of America, Washington, D.C. Inst. of Ocean Science and Engineering.

WIND INDUCED VIBRATIONS OF SKEWED CIRCULAR CYLINDERS

Gary H. Koopmann Sep. 1970 26 p refs

(Contract N00014-68-A-0508-0001)

(AD-717739; Rept-70-11) Avail: NTIS CSCL 20/4

A general discussion of the various techniques used to measure the oscillating lift coefficients of wind-induced vibrations of circular cylinders is presented. The discussion is summarized

with a brief outline of the various categories of research efforts being conducted on fluid-induced vibrations. Each category is referenced to an appropriate group of papers which exist in the literature. A simple method for determining the oscillating lift coefficient for the wind-induced vibration of a circular cylinder is developed and applied to a typical problem where the longitudinal axis of the cylinder is skewed relative to the direction of the oncoming flow.
Author (GRA)

N71-22170# California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.
EXPERIMENTAL VERIFICATION OF CAVITY-FLOW WALL EFFECTS AND CORRECTION RULES
Arthur K. Whitney, Christopher Brennen, and T. Yao-Tsu Wu Nov. 1970 32 p refs
(Contract N00014-67-A-0094-0012)
(AD-717393; E-97A-18) Avail: NTIS CSCL 20/4

The report is intended as a companion to Report No. E-111A.5, Wall Effects in Cavity Flows, by Wu, Whitney and Lin. Some simple rules for the correction of wall effect are derived from that theoretical study. Experiments designed to complement the theory and to inspect the validity of the correction rules were then carried out in a high-speed water tunnel. The measurements on a series of fully cavitating wedges at zero angle of attack suggested that of the theoretical models that due to Riabouchinsky is superior. They also confirmed the accuracy of the correction rule derived using that model and based on a measurement of the minimum pressure along the tunnel wall.
Author (GRA)

N71-22218# Joint Publications Research Service, Washington, D.C.
TRAVELING WAVE ON AN ELASTIC BODY MOVING IN AN IDEAL FLUID
V. I. Merkulov *In its* Hydrodyn. Probl. of Bionics 12 Mar. 1971 p 123–135 refs (See N71-22201 11-05)
Avail: NTIS

Since the traveling wave is considered a possible mechanism for reducing hydrodynamic resistance, it is important to determine the flow conditions under which a traveling wave with the requisite parameters will propagate in a self-oscillating regime. Results are presented of examination of the oscillation of an elastic plate, an elastic cylindrical shell, and elastic half-space when ideal fluid is flowing along them.
A.L.

N71-22219# Joint Publications Research Service, Washington, D.C.
VISCOUS INCOMPRESSIBLE FLUID FLOW ALONG A TRAVELING WAVE (NUMERICAL EXPERIMENTS)
V. N. Kalugin et al *In its* Hydrodyn. Probl. of Bionics 12 Mar. 1971 p 136–144 refs (See N71-22201 11-05)
Avail: NTIS

Finite difference method was used to calculate flow in the vicinity of the surface of a streamline body. The specific case examined was the nonstationary case of two dimensional flow of an incompressible viscous fluid in an infinite channel, one of the boundaries of which was in oscillatory motion in the form of a traveling wave. The functions of flow and vortex were determined, demonstrating the forming within the primary stream of a second flow and transition by this flow under certain traveling wave and flow parameters to a steady state.
A.L.

N71-22221# Joint Publications Research Service, Washington, D.C.
EXPERIMENTAL INVESTIGATION OF FLUID FLOW ALONG A TRAVELING WAVE
V. I. Merkulov et al *In its* Hydrodyn. Probl. of Bionics 12 Mar. 1971 p 153–157 (See N71-22201 11-05)
Avail: NTIS

Mathematical investigations of flow of a viscous fluid along a traveling wave utilize a system of coordinates linked with the wave crest. In such a system the region boundary becomes a constant undulating surface each point on which slips along the tangent toward the fundamental stream. Since the forces to which the body is subjected are independent of selection of inertial system of coordinates, a coordinate system linked to the wave crest was used in this investigation. The construction of the model, layout of measuring devices, and method of measurement are described.
A.L.

N71-22241# Cornell Univ., Ithaca, N.Y. Graduate School of Aerospace Engineering.
BOUNDARY LAYER SEPARATION
Demetrios Pyrros Telionis (Ph.D. Thesis) Sep. 1970 147 p refs
(Contract F44620-69-C-0063)
(AD-717772; AFOSR-70-2404TR) Avail: NTIS CSCL 20/4

The phenomenon of separation is one of the most critical features of the flow of viscous fluids about rigid bodies. In the two-dimensional steady-state case, Prandtls criterion (vanishing of skin friction) appears to be successful in predicting separation. Numerical integrations have indicated that the boundary-layer equations behave singularly at separation, and Goldstein has suggested analytical formulas describing this situation. Prandtls criterion fails to predict meaningful separation for unsteady problems and this seems to have been mostly unnoticed. A general and formal definition of boundary-layer separation is given, based on the concept of Goldsteins singularity. It is demonstrated how from this definition one can deduce meaningful criteria for the unsteady problem as well as other complicated cases, such as three-dimensional or compressible separation flow. A simple formula is suggested for the component of the velocity in the direction parallel to the wall; and it is demonstrated that this is in agreement with Goldsteins results for small distance from separation along the wall. A differential equation is derived from the momentum equation which contains the velocity profile at separation. A few applications are included, demonstrating solutions of this equation, which, in the unsteady case, contains the velocity of the phenomenon of separation too.
GRA

N71-22244# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
RADIATIVELY DRIVEN ACOUSTIC WAVES IN A GAS IN A CYLINDRICAL TUBE: THEORY AND EXPERIMENT FOR THE UNTUNED CONDITION
Gary T. Chapman Aug. 1970 239 p refs
(Contract N00014-67-A-0112-0017)
(AD-717643; SUDAAR-407; TR-2) Avail: NTIS CSCL 20/4

A detailed theoretical and experimental study of radiatively driven acoustic waves in a closed cylindrical tube has been made. The study concerns itself primarily with conditions for vibrational equilibrium of the gas and for the untuned conditions of the wave tube. The theoretical treatment considers all of the essential elements of the problem such as gas motion, longitudinal and radial heat conduction, longitudinal and radial viscous dissipation, and radiation including spectral details. In the light of this theoretical treatment some existing spectrophone data are then analyzed. These data are for conditions where the wave tube is much smaller than an acoustic wave. There is good agreement of basic trends; absolute values could not be compared. Tests are then described in which the absolute pressure level as well as the input radiation were measured. These tests were conducted in a wave tube 75-cm long by 10-cm in diameter. Some of the various test conditions were: Gas mixtures of CO2 and CO in argon, gas temperatures of 300K and 600K, wave numbers of 1/4, 3/4, and 5/4, and three different levels of input radiation. The general agreement between the results of these tests and theory was fairly good on both an absolute basis as well as with trends. Most of the areas

of disagreement were traceable to two sources: nonisotropy of the input radiant energy and the use of frequency-averaged absorption coefficients. Author (GRA)

N71-22287# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
CHARTS FOR EQUILIBRIUM, NONEQUILIBRIUM AND FROZEN FLOW PROPERTIES OF REACTING NITROGEN IN HYPERVELOCITY NOZZLES
N. M. Reddy and Fred L. Daum Oct. 1970 248 p refs
(AD-717704; ARL-70-0150) Avail: NTIS CSCL 20/4

The flow-property charts for pure nitrogen in a quasi-one-dimensional nozzle are presented. The flow conditions include chemical nonequilibrium in three different nozzle shapes as well as the corresponding equilibrium and frozen flow situations. The reservoir temperature range from 2000K to 13,000K is covered at intervals of 1000K. The reservoir pressures considered are 10, 50, 100, 200, 500 and 1000 atmospheres. Author (GRA)

N71-22294# Cambridge Univ. (England). Dept. of Engineering.
THE OFF DESIGN ANALYSIS OF FLOW IN AXIAL COMPRESSORS
H. Daneshyar 1970 56 p refs
(CUED/A-Turbo/TR-19) Avail: NTIS

The existence and uniqueness of the solutions obtained from the streamline curvature method of calculating flow through turbomachines are examined for several operating points of a Rolls-Royce compressor. It is shown that under certain conditions the truncation errors in the numerical solution can become large and hence give rise to the violation of the uniqueness conditions. The computer program may then give wrong answers to the physical problem. The conditions for existence and uniqueness may be violated when the meridional velocities are small (e.g. near stall) or when there are regions of choked flow. Flow for an operating point in the stall region is computed by suitable modifications to minimize the truncation errors and hence to obtain a unique solution. This is compared with the results of the actuator disc theory and other experiments. Author

N71-22295+ Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering.
NUMERICAL METHODS IN FLUID MECHANICS AND HEAT TRANSFER
D. B. Spalding Dec. 1970 51 p refs
(EF/TN/A/34) Avail: NTIS

Essential characteristics of methods developed for nonlinear partial differential equations in the field of fluid mechanics and heat transfer are submitted with special emphasis on elliptic flows. The relation of these methods to finite element procedures is discussed, also the importance of understanding and controlling the divergence that results from the interlinkages between simultaneous equations. Examples are described of computations of two-dimensional parabolic, hyperbolic and elliptic, and of three-dimensional parabolic flows. In some cases the phenomena are complicated by turbulence and by chemical kinetic processes. Author

N71-22326# Air Force Weapons Lab., Kirtland AFB, N.Mex.
SPSHELL, OILDROP, AND SPCLAM: THREE PROGRAMS TO SOLVE HYDRODYNAMICS PROBLEMS IN TWO DIMENSIONS Technical Report, Sep. 1969–Jan. 1970
Robert C. Reynolds Dec. 1970 89 p refs
(AD-717708; AFWL-TR-70-98) Avail: NTIS CSCL 20/4

Three programs have been written to solve two-dimensional hydrodynamics problems in a spherical, pure Eulerian coordinate system. An extensive analysis of the central program, SPSHELL, is given and the equations it solves are derived. A Fortran listing of each program is included with an explanation of the data deck needed to run it. Author (GRA)

N71-22328# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
THE UNSTEADY HYDRODYNAMICS AND CONTROL OF HYDROFOILS NEAR A FREE SURFACE Final Report, 1 Aug. 1969–30 Apr. 1970
Joseph I. Smullin and Erich K. Bender 22 Jan. 1971 87 p refs
(Contract N00014-70-C-0032)
(AD-717681; BBN-1970) Avail: NTIS CSCL 20/4

A discussion is given of the development of a digital computer program to compute hydrofoil loads and some aspect of hydrofoil control. The program computes the lift, pitching moment, and flap hinge moment on a two-dimensional hydrofoil with a trailing edge flap operating near a free surface with waves. The computational approach involves the numerical solution of an integral equation relating an upwash distribution to a kernel function and pressure distribution. The pressure distribution is expanded in a truncated Glauert series; the integration is carried out numerically using a Gaussian quadrature; and the coefficients of the Glauert series are evaluated by a minimum error collocation method. The control problem investigated involves the positioning of a pivoted hydrofoil by means of a servo-controlled trim tab. When the foil is pivoted at its quarter chord point and control is implemented solely by means of a servo tab, the system is virtually uncontrollable. However, by pivoting the foil off the quarter chord point or by augmenting the servo tab with a servo attached directly to the foil, the system can be controlled. Author (GRA)

N71-22330# Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering.
THE PREDICTION OF LAMINAR FLOWS USING A MODIFIED VERSION OF THE ELLIPTIC PROGRAMME
L. W. Roberts Sep. 1970 64 p refs
(EF/TN/B/31) Avail: NTIS

A series of comparisons were made between the solution provided by the program and the exact solution to the differential equations for certain special cases. The comparisons were made to provide information on the accuracy of the computed solutions and the effects of changes in boundary conditions. It was also intended that the information would show whether any changes to the basic program were necessary to improve accuracy, reliability, or ease of use. A preliminary investigation indicated that a re-arrangement of the grid in the region of the boundaries would be advantageous. In particular, the need to make certain assumptions about the principal flow direction near entrance wall corners would be eliminated, thus removing a potential source of error. This change in the basic program, and resultant modifications that stem from it, are fully described. Author

N71-22342# McGill Univ., Montreal (Quebec). Dept. of Mechanical Engineering.
SHOCK ATTENUATION IN A PERFORATED DUCT
J. H. T. Wu and P. P. Ostrowski [1971] 14 p refs
(Grant NRC A-1255)
(Rept-71-1) Avail: NTIS

Attenuation of a shock wave travelling through a constant area duct uniformly perforated on two opposite side-walls was investigated for cases where the particle velocity behind the shock is subsonic. Whitham's one-dimensional characteristics rule is applied and the effects of mass flux through the perforations are included together with the area contraction of the emerging jet, it's inclination angle, and the time lag in establishing the steady boundary conditions while the shock passes a row of perforations. Shock attenuation is measured with transducers and viewed by spark schlieren photography in an air-to-air 2 inch square shock tube for perforation ratios of 10, 23, 33 and 51% and for shock Mach numbers between 1.37 and 1.84. Good agreement between the present theory and experiment is observed for perforation ratios up to 33%. Author

N71-22345# Michigan Univ., Ann Arbor. Dept. of Naval Architecture and Marine Engineering.
THEORY OF HIGH ASPECT RATIO PLANING SURFACES
Technical Report, 1 May 1969 – 30 Apr. 1970
Young-Tsun Shen Nov. 1970 135 p refs
(Contract N00014-67-A-0181-0019)
(AD-717667; Rept-102) Avail: NTIS CSCL 13/10

A high-aspect-ratio planing surface gliding on a stream of an infinitely deep, incompressible, inviscid and gravity-free fluid is treated. This complicated problem is decomposed into two relatively simpler boundary-value problems: (1) The near-field boundary-value problem is valid only in the neighborhood of the planing surface. The problem is solved by the classical hodograph method. The second-order inner problem is also shown to be a plane, irrotational flow and the solution is obtained by following the same procedure as in the first-order inner solution. (2) The far-field boundary-value problem is valid only far away from the planing surface. The first-order outer solution is shown to be a trivial uniform flow. The outer velocity potential is defined in the whole space by harmonic continuation. The second-order solution is then shown to be similar to a lifting-line solution. The unknown strength of singularities is obtained by matching of the velocity potential. Then a matching of the free-surface deflection provides a height reference for the planing surface. The location of the planing surface with respect to the undisturbed free surface is uniquely defined. In order to obtain a unique second-order solution, it is necessary to solve the third-order outer solution. The detail of this solution is presented. A numerical solution for a planing plate of arbitrary angle of attack is presented. A downwash correction is also included. It is shown mathematically that the present theory can be applied to V-shape or general-shape planing surfaces with curvature in the spanwise direction. Author (GRA)

N71-22350# Lockheed Missiles and Space Co., Palo Alto, Calif.
TRANSONIC GAS FLOW AROUND A SYMMETRIC PROFILE
G. F. Sigalov 1970 5 p refs Transl. into ENGLISH from Samoletostr. Tekh. Vozdush. Flota (USSR), no. 20, 1970 p 20 – 24
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

A method of solving nonlinear equations is used to solve plane flow problems of aeromechanics in a nonlinear approximation. Compressible flow around a real profile is considered by starting from an incompressible flow around a known profile. The flow of an unbounded uniform adiabatic transonic inviscid gas around a symmetric profile is determined. The first approximation yields satisfactory results for moderate perturbations in a transonic flow. N.E.N.

N71-22428# Cambridge Univ. (England). Dept. of Engineering.
THE UNSTEADY RESPONSE OF AN AXIAL FLOW COMPRESSOR WITH A DISTORTED INLET FLOW
H. Mokelke 1970 37 p refs Presented at the Turbomachinery Subcomm. of the ARC Meeting, 2 Oct. 1970
(CUED/A-Turbo/TR-20) Avail: NTIS

A 4-stage axial flow compressor with a hub/tip ratio of 0.8 is first investigated with a circumferential 60 deg-square wave inlet flow distortion at a high and a low flow rate. By measuring the total pressures, static pressures and yaw angle behind each stage, the development of the distortion is followed through the compressor. It is found that some of the experimental results differ considerably from analytical results predicted by quasi-steady theories. These discrepencies are likely to be due to the unsteady response of the flow around the rotor blades while these are passing through a distorted region. The compressor was tested using two asymmetric inlet distortions which were mirror images of each other. For the case of a low flow rate, great differences in the profiles were recorded. It is believed that different types of short duration stall are responsible for this result. In the case of the higher flow the discrepancies are somewhat less and might conceivably be explained by unsteady potential flow theories. Author

N71-22429# Indian Inst. of Science, Bangalore. Dept. of Aeronautical Engineering.
STUDIES IN TWO DIMENSIONAL FLUID INJECTION FOR THRUST VECTOR CONTROL
T. A. Diab, G. Srinivasan, M. Krishnamurthy, R. Ravindran, and R. Narasimha Aeron. Res. Comm. Jun. 1969 29 p refs
(ARC-TR-1) Avail: NTIS

Experiments were conducted in a 1 in. × 3 in. supersonic wind tunnel on two-dimensional secondary fluid injection into a uniform primary supersonic stream. Both primary and secondary fluids were air at the same stagnation temperature, but the secondary stagnation pressure was varied from about 0.2 to 2.0 times the primary value; injection was sonic and the jet issued into the primary stream through a slit of constant width at 0 deg, 8 deg, 23 deg and 55 deg upstream (the angle being measured from the normal to the primary flow). Primary stream Mach number covered the range from 1.64 to 3.08 in the tests. The observed shape of the main shock does not correlate too well in the variables normally used in the blast wave theories, but two simple and plausible modifications, involving a translation of the virtual origin of the blast upstream of the jet and a replacement of a factor M (the primary Mach number) by (square root of M squared minus one), succeed in producing similarity among observed shocks. An expression in the modified variables is fitted to the similarity curve, which tends to a first order blast wave at small distances from the jet and to a Mach wave at large distances. It is also found that the separation shock in front of the main shock corresponds to a nearly constant flow deflection of about 10 degrees. Author

N71-22501*# Illinois Univ., Urbana. Engineering Experiment Station.
JET MIXING UNDER THE INFLUENCE OF A PRESSURE GRADIENT
D. F. Brink and W. L. Chow Apr. 1971 113 p refs
(Grant NGL-14-005-140)
(NASA-CR-117836; ME-TR-395-1) Avail: NTIS CSCL 20D

The problem of jet mixing under a non-constant pressure condition is examined in detail by theoretical analysis. The system of the non-similar boundary layer equations governing the flow phenomenon is solved by the asymptotic method of integrations. The analytical results provide evidence to the validity of the locally similar approximations under these flow conditions. The problem of relaxation from an initially non-similar flow field toward the final asymptotically similar flow is also examined and discussed. Author

N71-22576 Pennsylvania Univ., Philadelphia.
THE EFFECT OF WALL POROSITY ON THE STABILITY OF PARALLEL FLOWS OVER COMPLIANT BOUNDARIES
Harvey Worth Burden (Ph.D. Thesis) 1969 167 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 70-7783

A numerical technique is employed for solution of the coupled Orr – Sommerfeld/ stress-strain/strain rate equations for incompressible, viscous fluid flowing over a porous, compliant, viscoelastic boundary. The analysis shows that small amounts of porosity have the destabilizing effect of promoting transition and expanding the range of unstable disturbances. Both the temporal and spatial amplification rates are increased for all types of boundaries. The analytical and numerical methods are described in detail. The results are compared with those of comparable situations without porosity, which, in turn, are compared with results of previous investigations, both analytical and empirical. Spatial amplification rates, velocity perturbation profiles, and Reynolds stress profiles are shown for a selected number of conditions. Basic analysis is presented for the case of parallel flow through a uniform circular cylindrical tube with similar wall characteristics. Dissert. Abstr.

N71-22577 Pennsylvania State Univ., University Park.
TURBULENT MIXING OF A CONFINED AXISYMMETRIC

JET

Elias Razinsky (Ph.D. Thesis) 1969 219 p
Avail: Univ. Microfilms: HC $9.90/Microfilm $3.00 Order No. 70-7240

An experimental and analytical investigation of turbulent mixing in a confined axisymmetric jet was investigated. A high velocity air jet (primary) was directed into a constant diameter duct where it mixed with a concentric, low velocity, air flow (secondary). The experimental objectives of the research were to determine the static pressure distribution, mean velocity profiles and turbulence quantities for diameter ratios of 1/3 and 1/6 and velocity ratios of 2 and 9. These measurements were made from the initial mixing tube location where there was a step change in the uniform primary and secondary velocities to the downstream location where the flow was fully developed. A theoretical model of the flow was developed which included the wall boundary layer. The results gave the rate of spread of the jet, boundary layer thickness, pressure distribution and mean velocity values. These theoretical results were then compared with the experimental measurements and predictions made by other investigators. Dissert. Abstr.

N71-22584 Missouri Univ., Columbus.
INTERFACIAL TENSION IN A BINARY LIQUID SYSTEM

George William Paul (Ph.D. Thesis) 1969 95 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 70-6622

The interfacial tension and the density difference between the mutually saturated phases carbon tetrachloride-perfluoromethylcyclohexane have been determined as a function of temperature. Interfacial tensions were measured by the drop-volume technique and the densities by the hydrostatic method. The data are reported for 35 temperatures which range from Tc-T = 0.058 to 20.65 C, where Tc = 28.625 + or − 0.005 C is the critical solution temperature of the mixture. The data may be fit to power law forms. These results are shown to be in agreement with certain of the scaling law predictions. Dissert. Abstr.

N71-22587 Pennsylvania State Univ., University Park.
SINGULAR PERTURBATION THEORY OF TURBULENT BOUNDARY LAYERS WITH NEGLIGIBLE WALL STRESS

Tara Chand Chawla (Ph.D. Thesis) 1969 106 p
Avail: Univ. Microfilms: HC $5.40/Microfilms $3.00 Order No. 70-7192

In the present analysis, for the first-order theory, a single-layer model utilizing the free-stream velocity, U sub o, as the velocity scale and the boundary-layer thickness as the length scale is proposed in the belief that at infinitely large Reynolds numbers the boundary layer with zero wall stress is primarily constrained by inertia effects, rather than by viscosity, and that the effects of the constraints of the wall and the viscosity are second-order effects. To include these second-order effects, a two-layer model is adopted. It is found that the appropriate scales for second-order wall layer are the pressure velocity and the viscous length. The second-order outer layer is a velocity-defect layer, which utilizes U sub s as the velocity scale and sigma as the length scale. In between these two regions there is a blending or overlap region. In this overlap region the asymptotic matching between the second-order law of the wall and the second-order defect law, is performed. Dissert. Abstr.

N71-22588*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
COMPUTER PROGRAM FOR COMPRESSIBLE LAMINAR OR TURBULENT NONSIMILAR BOUNDARY LAYERS

Barbara A. Hixon, Ivan E. Beckwith, and Dennis M. Bushnell Washington Apr. 1971 82 p refs
(NASA-TM-X-2140; L-7399) Avail: NTIS CSCL 20D

A computer program is described which solves the two-dimensional and axisymmetric forms of the compressible-boundary-layer equations for continuity, mean momentum, and mean total enthalpy by an implicit finite-difference procedure. Turbulent flow is treated by the inclusion of an eddy viscosity model based upon a mixing-length formulation. The eddy conductivity is related to the eddy viscosity by the turbulent Prandtl number which may be an arbitrary function of the distance from the wall. The laminar-boundary-layer equations are recovered when the eddy viscosity is zero. Since a finite-difference procedure is used, the effects of variable wall and edge boundary conditions are easily included by modifying the program inputs. Author

N71-22589*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ANALOG ANALYSIS OF THE HEAVE RESPONSE AND CONTROL OF A PLENUM-TYPE AIR CUSHION VEHICLE

Jack D. Leatherwood Washington Apr. 1971 31 p refs
(NASA-TN-D-6257; L-7227) Avail: NTIS CSCL 01C

An analytical investigation was conducted to determine the basic heave response characteristics of a plenum-type tracked air-cushion vehicle as a function of vehicle operating parameters. In addition to determining basic characteristics, the effect of an active lip control system on the vehicle dynamic response was investigated. Nonlinear equations describing the dynamic and thermodynamic state of the air-cushion system were derived, and the response of the system to sinusoidal perturbations of the guideway was obtained with the use of an analog computer. Results are presented in terms of vehicle-to-guideway motions and vehicle accelerations experienced during fundamental and subharmonic oscillations. Author

N71-22626 Advisory Group for Aerospace Research and Development, Paris, France).
NEW EXPERIMENTAL TECHNIQUES IN PROPULSION AND ENERGETICS RESEARCH

David Andrews and Jean Surugue, eds. Oct. 1970 637 p refs Conf. held at Munich, 11–15 Sep. 1967
(AGARD-CP-38) Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The experimental techniques developed for diagnosing high velocity flows include shock tubes, optical methods, enthalpy probes, mass spectrometry, molecular beams, measurements using ionization, plasma flow measurements, and gas chromatography. For individual titles, see N71-22627 through N71-22655.

N71-22627 Avco-Everett Research Lab., Everett, Mass.
NEW EXPERIMENTAL TECHNIQUES FOR KINETIC STUDIES IN SHOCK TUBES

K. L. Wray *In* AGARD New Exptl. Tech. in Propulsion and Energetics Res. Oct. 1970 p 17–52 refs (See N71-22626 11-12)
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The advantages, limitations, and applications of new kinetic techniques are reviewed. Those that are discussed are divided into two categories: (1) diagnostic techniques applicable to monitoring time histories behind shock waves; and (2) techniques which may be used in the preparation of nonequilibrium distributions, either in the unshocked gas or behind the shock. In the first category are such methods as infrared emission and absorption, electron absorption and scattering, the hook method, which uses a spectrometer crossed with an interferometer, mass spectrometry, laser interferometry, and some new concepts in single pulse shock tubes. In the second category are techniques such as electric discharges, flash photolysis, and the production of free radicals by shocking unstable molecules. Also included in this category is the two phase shock tube. Author

N71-22628 Cornell Aeronautical Lab., Inc., Buffalo, N.Y. Aerodynamic Research Dept.

THE ROLE OF SHOCK TUBES IN OPACITY MEASUREMENTS

W. Wurster *In* AGARD New Exptl. Tech. in Propulsion and Energetics Res. Oct. 1970 p 53–69 refs (See N71-22626 11-12)

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Quantitative spectral studies of the radiation from molecules, atoms and electrons are discussed. These studies demonstrate the usefulness of the shock tube in obtaining the fundamental radiative constants for these systems. Instrumental unique to such studies, from the infrared to the vacuum ultraviolet, are described. Critical problems associated with spectral purity and species identification are stressed. Finally, the discussion includes the extension of these techniques to the study of radiation from normally solid species.
Author

N71-22629 Heliodyne Corp., Van Nuys, Calif.

SHOCK TUBE STUDIES ON TWO PHASE SYSTEMS

W. J. Hooker, A. L. Morsell, and R. Watson *In* AGARD New Exptl. Tech. in Propulsion and Energetics Res. Oct. 1970 p 71–90 refs Sponsored in part by ARPA

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A shock tube facility is described which employs a two-phase system of solid particles and gases as the primary driven fluid. The techniques for producing and uniformly suspending the particulate matter in the driven section of the shock tube are discussed, and comparisons between calculated and measured particle vaporization times behind a shock wave are presented. A description is given of a new concept in optical instrumentation which permits high resolution, time resolved absorption spectra to be obtained for a shock tube flow, which greatly reduces the amount of experimentation required to define the reaction kinetics of a complex chemical system. The application of the two-phase shock tube to studies of hypervelocity impact phenomena is described, and experimental data is presented.
Author

N71-22630 Sheffield Univ. (England).

COMBUSTION RESEARCH IN A SHOCK TUNNEL

J. Swithenbank and R. J. Parsons *In* AGARD New Exptl. Tech. in Propulsion and Energetics Res. Oct. 1970 p 91–122 refs Sponsored in part by Min. of Technol. (See N71-22626 11-12)

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In addition to conventional pressure and shock speed instrumentation, the feasibility of the measurement of gas velocity by electromagnetic induction was studied and found to be a promising technique at the higher flight speeds. Radio frequency probes were used to indicate its magnitude. High speed gas sampling valves are used to measure the fuel concentration in the mixing region, however care must be taken with probe design. The proven value of flow visualization techniques are attained by high speed cine photography.
Author

N71-22631 National Aero-and Astronautical Research Inst., Amsterdam (Netherlands).

SHOCK TUBE TECHNIQUES FOR FUEL DROPLET COMBUSTION STUDIES

F. Jaarsma and W. Merksen *In* AGARD New Exptl. Tech. in Propulsion and Energetics Res. Oct. 1970 p 123–150 refs (See N71-22626 11-12)

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The interaction between shockwaves and burning or nonburning fuel droplets in a pure oxygen atmosphere were studied. Particular attention was given to the distortion of the initial disturbance due to the passing shockwave. The droplet shattering process was studied in the burning and nonburning mode as well as the distortion of the flame and the wave. The investigations which have been carried out cover the range of extreme weak shocks (M = 1.04) up to shockwaves of the detonation speed in pure oxygen atmosphere at different initial pressures, containing a single, well defined, burning or nonburning fuel (Diethylcyclohexane) droplet. A description is given of the shock tube, droplet injection system, ignition system, Cranz-Scharding optical observation system, triggering sequence and safety precautions. The experimental technique is compared with other techniques on studies of the droplet and liquid jet shattering process. The experimental results show that at almost all shockwave Mach numbers and initial pressures (from 0.2 to 4.7 ata) the fuel droplets shatter in the sheartype mode. Except at very low Weber numbers the characteristic deformation time and break-up time or burning time depend primarily on the dynamic pressure of the flow behind the shock and also weakly on the pressure step across the shock. These characteristic times can be reasonably well predicted from a simple theoretical model.
Author

N71-22633 AC Electronics-Defense Research Labs., Santa Barbara, Calif.

AEROPHYSICS RESEARCH BASED ON FREE FLIGHT RANGE MEASUREMENTS

A. Q. Eschenroeder, H. H. King, and K. S. Wen *In* AGARD New Exptl. Tech. in Propulsion and Energetics Res. Oct. 1970 p 165–188 refs (See N71-22626 11-12)

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The recent advances in techniques which have significantly extended the application of free-flight ranges to the study of high temperature gas-dynamic phenomena are discussed with the improvements in the resolution of information available from laboratory scale flight investigations. Two approaches are followed in relating subscale and full scale observations: direct scaling and evolution of theoretical description. In the first approach, classical results of similitude are extended to include modeling of nonequilibrium chemistry. The second approach requires a detailed mathematical model that contains the essential physical features of interest. The model is refined using the experimental findings. Within the scope of this theoretical system observations of both small and large scale events are predictable. Evidently, the analytical approach is the more general of the two.
Author

N71-22634 New York Univ., N.Y.

A FACILITY FOR HYPERSONIC FLOW SIMULATION OVER BLUNT NOSED BODIES

V. Zakkay and W. H. Mak *In* AGARD New Exptl. Tech. in Propulsion and Energetics Res. Oct. 1970 p 189–209 refs (See N71-22626 11-12)

(Contract AF 33(615)-3236)

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A facility for simulating reentry flow fields over blunt-nosed bodies is presented. By using H2O-O2 mixture, it is shown that simulation may be achieved at lower stagnation temperatures. The criteria for simulation of supersonic flow over blunt-nosed bodies using any gaseous test medium were found to be the dynamic pressure and the density ratio across the normal shock. The effect of gamma for different gases chiefly affects the surface Mach number distribution. Combustion gases may be used as an aerodynamic test medium, provided that water vapor condensation

is avoided and that equilibrium flow conditions are ensured. In the H2O-O2 mixture family, a mixture of equivalence ratio gamma = 0.2035 has been found to yield density ratios of the order of ten across a normal shock in equilibrium flow by suitably adjusting the pressure level. A buffered shock tunnel test facility is proposed to use the H2O-O2 (gamma = 0.2035) mixture as the test medium. Flow Mach numbers of the order of ten can be attained at a static temperature of 300 K. Operating conditions have been determined for the heated air driver, the helium buffer and the H2O-O2 mixture. Author

N71-22636 Institut fuer Plasmaphysik, Munich (West Germany).
INTERFEROMETRIC MEASUREMENTS IN OPTICAL AND MICROWAVE FREQUENCY RANGES ON ELECTROMAGNETICALLY ACCELERATED SHOCK WAVES
H. Muntenbruch *In* AGARD New Exptl. Tech. in Propulsion and Energetics Res. Oct. 1970 p 243-255 refs Sponsored in part by EURATOM (See N71-22626 11-12)
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Fast shock waves which can be produced in light gases electromagnetically are studied. With such shock waves a distinction is made between two regions: the shock wave heated gas immediately behind the shock front and the plasma cloud heated in the electric discharge. Interferometric measurements on shock waves in hydrogen show that these regions are only separated from one another up to about M = 20. The blast wave character of the waves can be clearly observed both in the time dependence of the shock front velocity and in the density distribution behind the front. These results are confirmed by microwave measurements, which also show different behavior of the electron density due to relaxation effects. Author

N71-22637 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
VISUALIZATION OF LOW VOLUMETRIC MASS [VISUALISATION A FAIBLE MASSE VOLUMIQUE]
Claude Veret *In* AGARD New Exptl. Tech. in Propulsion and Energetics RES. Oct. 1970 p 257-269 refs In FRENCH; ENGLISH summary (See N71-22626 11-12)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The schlieren and phase contrast methods used for the visualization of supersonic flow are revised. Both methods are described and their sensitivities are compared. Examples of wind-tunnel hypersonic flow visualizations are given. The conditions for the application of these methods to the visualization of flows that are themselves luminous (plasmas and flames) are indicated. Author

N71-22673 New York Univ., N.Y. School of Engineering and Science.
VISCOUS INTERACTIONS AT HIGH MACH NUMBERS IN ARBITRARY PRESSURE FIELDS
Sanford Mark Dash (Ph.D. Thesis) 1969 113 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 70-9770

A numerical method for the analysis of axisymmetric or two-dimensional viscous flows is presented. The method is applied to the analysis of hypersonic flow fields in the vicinity of two dimensional curved walls. The flow field is divided into three regions: (1) an inviscid supersonic outer flow, (2) a supersonic viscous layer, and (3) a viscous transonic-subsonic layer adjacent to the wall. The supersonic regions are solved by the method of characteristics with the shear terms treated as prescribed functions while the viscous sublayer is solved by an implicit finite difference formulation of the higher order boundary layer equations. The interaction effects evolve from the matching of the inner sublayer with the supersonic viscous layer. Results of the analysis indicate that at hypersonic velocities, there are significant variations in streamline curvature between the wall and the outer stream, hence large pressure gradients exist in a direction normal to the streamlines that cannot be accounted for in the classical boundary layer analysis. Dissert. Abstr.

N71-22674 New York Univ., N.Y. School of Engineering and Science.
NUMERICAL SOLUTION OF SEVERAL STEADY WAKE FLOWS OF THE MIXED SUPERSONIC/SUBSONIC TYPE BY A TIME-DEPENDENT METHOD
John Istvan Erdos (Ph.D. Thesis) 1969 79 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 70-9772

The analysis of steady, mixed supersonic/subsonic flow fields involved difficulties associated with the elliptic character of the differential equations governing the subsonic regime, and the resulting interactions between the subsonic and supersonic regions. The complexities of a mixed elliptic-hyperbolic problem can be effectively circumvented by transforming it into a purely hyperbolic problem through introduction of an additional, albeit artificial, time variable. The present investigation considers the near wake of a flat-based slender body at supersonic speeds in the context of this type problem. Inviscid solutions are obtained by a finite-difference method known as the two-step Lax-Wendroff technique. This study demonstrates that an inviscid model of the closed near wake exhibits remarkable agreement with the available experimental data at even moderately low Reynolds numbers. Dissert. Abstr.

N71-22675 Iowa State Univ. of Science and Technology, Ames.
NUMERICAL COMPUTATION OF INTERMEDIATE ALTITUDE ROCKET EXHAUST PLUMES, INCLUDING NONEQUILIBRIUM CHEMICAL REACTIONS AND DIFFUSION
John Charles Tannehill (Ph.D. Thesis) 1969 243 p
Avail: Univ. Microfilms: HC $11.05/Microfilm $3.15 Order No. 70-7745

A method for numerically calculating the flow in intermediate altitude rocket exhaust plumes is described. The method used is a modification of the Lagrangian finite-difference technique developed by Bynton and Thomson for calculating the flow in high altitude rocket exhaust plumes. This technique is extended to intermediate altitude rocket exhaust plumes by incorporating chemical nonequilibrium and turbulent transport capabilities into the analysis. Chemical nonequilibrium is handled through the use of either an implicit or an explicit technique. In the implicit technique, the species continuity equations are first put into finite-difference form and then are linearized by employing Moretti's method. The resulting algebraic equations in terms of the unknown molar concentrations are solved using the Gauss-Jordan method. In the explicit technique, all variables in the species production term in the species continuity equations are evaluated using known quantities from previous calculations, thus permitting an immediate solution. Dissert. Abstr.

N71-22680*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COOLING AIRFLOW THROUGH A STATIONARY TURBINE DISK AND BLADE
Frederick C. Yeh, David J. Poferl, Reaves P. Cochran, and Hadley T. Richards Washington Apr. 1971 44 p refs
(NASA-TM-X-2171; E-6006) Avail: NTIS CSCL 20D

The cooling-air pressure changes through a stationary turbine disk and blade assembly and the airflow distribution within a blade were determined experimentally. Tests were conducted with room-temperature air over a range of inlet pressures from 28 to

100 psia and flow rates from 0.12 to 0.45 lb/sec. Based on demonstrated agreement between measured and calculated rotor disk and blade pressures, an analytical procedure is proposed for predicting the cooling-air pressure changes through the rotor disk and blade during engine operation. Author

N71-22681*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL INVESTIGATION OF TWO METHODS FOR GENERATING AN ARTIFICIALLY THICKENED BOUNDARY LAYER
David F. Johnson and Glenn A. Mitchell Washington Apr. 1971 38 p refs
(NASA-TM-X-2238; E-5997) Avail: NTIS CSCL 20D

A study has been made of techniques for generating an artificially thickened boundary layer on a flat plate. The boundary-layer generation was accomplished by means of locating protuberances on the leading-edge surface of the plate. Two protuberance designs were investigated: cylindrical and biconical. The investigation was conducted at Mach numbers 2.3 to 2.6 and at a Reynolds number of 2.4 × 1,000,000 per foot (7.87 × 1,000,000/m). The results of the investigation revealed that both protuberances were effective in thickening the boundary layer. However, the conical protuberances produced thicker boundary layers with less flow distortions. Author

N71-22690 Tennessee Univ., Knoxville.
LAMINAR FLOW OF A NON-NEWTONIAN FLUID THROUGH AN ABRUPT CONTRACTION OR EXPANSION
David Hardwick (Ph.D. Thesis) 1969 193 p
Avail: Univ. Microfilms: HC $8.80/Microfilm $3.00 Order No. 70-7571

Shear rate - viscosity data for solutions of secondary cellulose acetate in acetone at 40 C were determined experimentally for shear rates between 0.1 and 1,000,000/sec. A falling head capillary viscometer and a rotational viscometer were used for shear rates below 50/sec. An Instron capillary rheometer provided the higher shear rate data. The Powell Eyring rheological model gave the best fit and physical interpretation of the data predicting a low shear rate viscosity of 579 poise and an infinite shear rate viscosity of 22 centipoise. The full equations governing the laminar flow of an inelastic, incompressible, non-Newtonian fluid through a circular pipe with an abrupt 2:1 change in diameter were solved numerically by the steady approach. Second order partial differential equations (reduced from a constitutive equation and the equations of momentum and continuity) with vorticity, stream function and viscosity as variables were used as basic equations in the computations. The finite-difference equivalents of the differential equations were used in the numerical solution. Dissert. Abstr.

N71-22691 Purdue Univ., Lafayette, Ind.
A STOCHASTIC MODEL OF TURBULENT CHANNEL FLOW
Jay Charles Hardin (Ph.D. Thesis) 1969 149 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 70-8897

The problem of predicting the turbulent characteristics of the velocity field associated with a given, non-constant mean velocity profile is considered. Such shear turbulence is insoluble from its describing equations due to the non-homogeneity of the flow, in addition to the usual non-linearity and closure difficulties. In this analysis, a stochastic model of turbulent channel flow is developed. This flow was chosen for its relative simplicity and abundance of experimental data available. The model is based only upon energy considerations and knowledge of the mean velocity profile, yet provides a description of the entire turbulent field. Dissert. Abstr.

N71-22700 Alabama Univ., University.
THE ARTIFICIAL VISCOSITY METHOD FOR BLUNT BODY FLOW FIELD ANALYSIS INCLUDING THE EFFECTS OF THERMAL RADIATION
James Otis Nichols (Ph.D. Thesis) 1969 148 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 70-9371

A comparison of several artificial viscosity methods of blunt body flow field analysis is made and methods are derived for including radiation effects. The body used was a semiinfinite flat plate of finite thickness with flat leading edge normal to the freestream. The freestream conditions were the standard atmospheric conditions occurring at 150,000 ft altitude. Two Mach numbers were considered, M = 10 and M = 30. The solution was found by numerical integration of the unsteady flow equations written as finite difference equations. The steady-state solution was found by allowing a large number of time steps. It was found that radiation effects for a gray optically thin gas can be included at the lower Mach number. At the higher Mach number a modification of the differencing scheme was required in order to include the radiation effects. Heat transfer rates to the flat-faced body are presented. Dissert. Abstr.

N71-22701 North Carolina State Univ., Raleigh.
ON THE EFFECTS OF LENGTH ON TRANSITION FROM SUPERSONIC TO SUBSONIC FLOW IN A TUBE AT LOW REYNOLDS NUMBERS
George Fong-jen Lee (Ph.D. Thesis) 1969 160 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 70-9196

The low density gas stream being produced by a supersonic nozzle and flowing through a 2 1/2 inch copper tube having length to diameter ratios up to 12 was studied experimentally. The static pressure along the tube and the flow characteristics at upstream and downstream stations of the tube were examined. The effects of tube length on the flow were examined by performing six tests with different tube lengths in which the Knudsen number ranged from 0.0027 to 0.027 and the Reynolds number from 20 to 500. For supersonic flow in the upstream portion of the tube, the transition was found to be complete within a very short distance of the tube entrance and the flow phenomenon was characterized by strong viscous effects and an adverse pressure gradient. For subsonic flow at the tube entrance, a developing flow near a tube entrance was observed. Dissert. Abstr.

N71-22702 South Carolina Univ., Columbia.
COMBINED FREE AND FORCED LAMINAR NON-NEWTONIAN CONVECTION IN A VERTICAL TUBE
Wilbur Joseph Marner (Ph.D. Thesis) 1969 116 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 70-9306

Heat transfer to a power law fluid flowing in a constant wall temperature vertical tube was studied. Except for a linear variation of density with temperature, all properties were assumed to be constants. An initially fully developed velocity profile was assumed for the analysis. Nondimensionalization of the governing equations showed the parameters controlling the problem to be: flow behavior index n, Prandtl number Pr, and the Grashof over Reynolds number ratio Gr/Re. The dimensionless groups are defined in the generalized sense for power law fluids. The governing equations were solved numerically for a range of the parameters. Mean Nusselt numbers, dimensionless pressure drop, and typical developing dimensionless velocity and temperature profiles are presented. Results show that distortion of the velocity profile due to free convection effects can increase the heat transfer and pressure drop significantly. Dissert. Abstr.

N71-22720 Iowa State Univ. of Science and Technology, Ames.
VIBRATIONAL RELAXATION OF ANHARMONIC OSCILLATORS WITH VIBRATION-VIBRATION AND VIBRATION-TRANSLATION ENERGY EXCHANGE

Francis Hugh Maillie (Ph.D. Thesis) 1969 148 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 70-7723

The model chosen for analysis consisted of a small concentration of excited anharmonic oscillators immersed in a constant temperature heat bath of similar oscillators which allowed for collisional processes involving both vibration-vibration and vibration-translation energy exchange by the gas. Numerical examples for the N2 oscillator were carried out under the following conditions; T = 500 K and T sub vo = 2000 K, T = 1000 K and T sub vo = 4000 K and T = 2000 K and T sub vo = 8000 K. It was found that the oscillator number distribution resulting from the master relaxation equations was highly nonBoltzmann, the upper quantum levels being greatly underpopulated when compared to a Boltzmann distribution supported by the same vibrational energy. Under the same conditions the first moment equation had upper level oscillator distributions that were always overpopulated during the relaxation process. The behavior of the quantities is similar in both models, with faster relaxation occurring in the first moment equation model. In both models vibration relaxation time varies during the relaxation process. Dissert. Abstr.

N71-22725 New York Univ., N.Y. School of Engineering and Science.
A NUMERICAL STUDY OF STEADY LAMINAR NATURAL CONVECTION IN A VERTICAL RECTANGULAR ENCLOSURE
Arthur Rubel (Ph.D. Thesis) 1969 210 p
Avail: Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 70-9788

Expanding the dependent variables of the governing equations in terms of the density difference parameter separates the problem into two parts. The basic nonlinear character of the flow is described by a zeroth order set of equations whereas modifications due to property variations, including density, are found from the solution of the first order equations. The details of the finite difference solution of the derived equations are described with particular emphasis given to a stable and rapidly converging iteration scheme for the solution of the zeroth order set of equations. This set consists of a nonlinear fourth order equation in the stream function and a coupled second order energy equation for the temperature. The results of this numerical study are shown to be consistent with existing experimental results and with the numerical calculations of others. Dissert. Abstr.

N71-22761 California Univ., Los Angeles.
THE EVOLUTION OF THE LAMINAR WAKE AND ITS UPSTREAM INFLUENCE
Lawrence Irving Schneider (Ph.D. Thesis) 1969 106 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 70-8201

The development of the wake behind a flat plate with zero thickness aligned with the flow at infinity is investigated. It is assumed that the Reynolds number based on plate length is sufficiently large that well developed thin boundary layers are to be found on the top and bottom of the plate. The two boundary layers merge symmetrically to form a wake upon separation at the trailing edge. It is found that characterization of the flow near the trailing edge requires an inner layer in which the full Navier-Stokes equations must be used and an outer layer in which the Euler equations apply. Solutions in these regions are coupled by a solution of the Prandtl boundary layer equation in an intermediate layer. The effect of second order boundary layer theory in the form of a non-uniform inviscid stream due to displacement thickness interaction is a significant feature of the problem. Coordinate transformations in both the tangential and normal directions are introduced in order to achieve uniform scaling of all the terms in the governing equations. Dissert. Abstr.

N71-22763 Pittsburgh Univ., Pa.
AN EXPERIMENTAL STUDY OF VELOCITY PROFILES AND PRESSURE LOSSES DURING PULSATING NEWTONIAN FLOW IN A RIGID TUBE
Edward Martin Phillips (Ph.D. Thesis) 1969 445 p
Avail: Univ. Microfilms: HC $20.05/Microfilm $5.70 Order No. 70-7880

Analytical closed form expressions have been obtained for pulsatile Newtonian laminar flow with mean flow in a horizontal rigid tube. Correlations in terms of dimensionless variables have been established for instantaneous values of the velocity profile, average velocity and friction factor. Spontaneous turbulence measurements demonstrated that laminar pulsatile flow prevailed up to a mean flow Reynolds number of 2200. Pulsatile flow development lengths were comparable in magnitude to steady flow values and in no case were more than 15 per cent greater than the steady state length. Experimental and theoretical reduced pulsatile velocity profiles were parabolic in shape and oscillated about the steady state velocity profile during the pulse cycle. Dissert. Abstr.

N71-22769 California Univ., Los Angeles.
MASS TRANSFER IN SELF-SIMILAR LAMINAR BOUNDARY LAYER FLOWS
Andrew Wortman (Ph.D. Thesis) 1969 364 p
Avail: Univ. Microfilms: HC $16.45/Microfilm $4.00 Order No. 70-8228

A method for efficient solution of the general self-similar boundary-layer equations, and use of the method to perform extensive parametric studies of several classes of boundary-layer flows is presented. The study may be divided into two sections: (1) development of the method of solution of nonlinear two point boundary value problems and (2) application of the method to parametric studies of two-dimensional binary gas boundary-layer flows, recovery enthalpies and three-dimensional stagnation point flows. It is shown that the general self-similar boundary-layer problem may be expressed in the form of a nonlinear operator on the solution vector whose components are the stream functions, enthalpy and concentration functions. With this approach two and three-dimensional multicomponent boundary-layer flows are shown to be members of a single class of mathematical problems which may be successfully attacked with techniques of nonlinear analysis. Dissert. Abstr.

N71-23005 Institute of Paper Chemistry, Appleton, Wis.
A STUDY OF DYNAMIC WETTABILITY ON A HYDROPHOBIC SURFACE
David E. McIntyre (Ph.D. Thesis) 1969 185 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 70-7938

A dynamic three-phase system and the effects of velocity and acceleration of the fluid on the instantaneous wetting properties of the system are discussed. Small drops of water and glycerol-water mixtures were driven in steady-state oscillation in the ellipsoidal mode of deformation on smooth paraffin surfaces. This oscillation was achieved using an electromagnetic coil to drive a steel platform supporting a paraffin surface with a very small amplitude at the resonant frequency of the drop under observation. The oscillations of the drop and the large dynamic contact angle changes were recorded with high speed filming techniques. The shape changes of the drops were measured from the films on a microcomparator. The contact angles were measured on projections of the films using a specially designed tangentometer device. Dissert. Abstr.

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N71-21858# Naval Oceanographic Office, Washington, D.C.
CURRENTS AND WATER EXCHANGE IN DNESTROVSKIY LIMAN [O TECHENIYAKH I VODOOBMENE DNESTROVSKOGO LIMANA]
M. Sh. Rozengurt 1970 15 p refs Transl. into ENGLISH from Akad. Nauk URSR, Inst. Biol. Piudennykh Moriv, Tr. (Kiev), v. 20, no. 2, 1967 p 50–59
(AD-717321; NOO-TRANS-502) Avail: NTIS CSCL 8/8

The existing current pattern in Dnestrovskiy liman, oriented in NW-SE direction, is discussed, pointing out its variations with seasons and years, which are induced by variations in precipitation and winds. In addition, the salinity variations are accounted for by using actual measurements and calculations. As the Dnestr water is increasingly used for irrigation, the existing current pattern and salinity values are changing. This effect will increase when the plan of excavating a canal connecting Danube with the Dnestr liman is materialized. Calculations based on measurements demonstrate the possible changes in water balance, currents and salinity. Author (GRA)

N71-21887# Joint Publications Research Service, Washington, D.C.
SPACE COLORS OF THE EARTH
K. Kondratyev et al 15 Mar. 1971 9 p Transl. into ENGLISH from Nauka i Zhizn' (Moscow), no. 12, 1970 p 16–18
(JPRS-52615) Avail: NTIS

The variable spectrum of colors of the earth as viewed from space is discussed in terms of the structure of the earth's atmosphere. An analysis of available information shows that the color pattern of the twilight halo is sensitive to high altitude ozone and aerosol heterogeneities in the atmosphere. F.O.S.

N71-21889# Joint Publications Research Service, Washington, D.C.
INFLUENCE OF THE ARCTIC ON THE CLIMATE OF THE USSR
Stepan Ivanovich Zhakov 30 Mar. 1971 95 p refs Transl. into ENGLISH of Monograph 'Vliyaniye Arktiki na Klimat SSSR' Leningrad, Hydrometeorological Publishing House, 1969 84 p
(JPRS-52756) Avail: NTIS

The effects of the Arctic Basin on temperature and moisture conditions in the USSR are investigated. The heat balance, heat transfer, and advection currents are discussed, and their influence in cooling the land air is described. The Arctic air intrusion also play a dominant role in the mechanisms of moisture condensation and precipitation formation. The intrusions cause up to 60% of summer precipitation, up to 70% during the transitional seasons, and even more during winter. About half of the moisture is acquired on the continent. N.E.N.

N71-21891 National Lending Library for Science and Technology, Boston Spa (England).
THE ORIGIN OF FRAMBOIDAL FORMS OF PYRITES [K VOPROSU O PROISKOZHDENII FRAMBOIDALNIKH FORM PITITA]
L. Ya. Kizilstein Sep. 1970 13 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Geol. (USSR), v. 5, 1969 p 61–68
(NLL-RTS-5966) Avail: Natl. Lending Library, Boston Spa, Engl.: 26 s; 4 NLL photocopy coupons

The structure and formation of framboid aggregates from coal seams of the Donets Basin are described. Structural etching was used to reveal the internal fine structure. Both bacterial and nonbacterial theories of origin are discussed, and it is concluded the bacterial approach is preferred. This is based on Love's isolation of microorganism remains from framboids, the actual appearance of microorganisms whose pyritization leads to the formation of framboids, and the very precise and complex structure of the framboids. The systematic position and ecology of the microorganisms responsible for framboid formation are also discussed. N.E.N.

N71-21892# National Environmental Satellite Center, Washington, D.C.
POTENTIAL OF SATELLITE MICROWAVE SENSING FOR HYDROLOGY AND OCEANOGRAPHY MEASUREMENTS
John C. Alishouse, Donald R. Baker, E. Paul McClain, and Harold W. Yates Mar. 1971 22 p refs
(NOAA-TM-NESS-26) Avail: NTIS

Hydrologic or oceanographic use of visible or infrared radiation measurements from earth satellites is seriously limited by the opacity of clouds at these wavelengths. Microwave radiation at frequencies which are subject to relatively small attenuation by clouds and other atmospheric constituents offers a means to circumvent this limitation. Microwave sensors that can be carried on unmanned satellites should be able to provide measurements usable for the delineation of snow and ice cover and the detection of precipitation; also, there is considerable promise that soil moisture measurements that are quantitative to some degree can be made. Microwave radiometers on unmanned satellites appear usable for detecting sea-ice boundaries through clouds and for obtaining information of sea-surface roughness and temperatures. Author

N71-21894# Engineer Agency for Resources Inventories, Washington, D.C.
NATURAL RESOURCES: A SELECTION OF BIBLIOGRAPHIES
Mary Anglemyer Nov. 1970 154 p refs
(AD-717255; EARI-3) Avail: NTIS CSCL 5/3

A managed program of data collection, storage and retrieval is basic to any systematic analysis of a nation's resources. This is accomplished at EARI by a continuing program of data acquisition involving domestic and foreign travel, national and international purchase and exchange arrangements and intensive collection research. The results of this program are maintained in a working file of selective hard copy material and to a much greater degree in a voluminous research card catalog containing appropriately indexed references to resource data held in other repositories throughout the world. The term natural resources is interpreted to include atmosphere, earth, water, climate, plants and animals individually and in interrelationship. Bibliography is used as any list which is arranged either by subject, or geographically, or in a form which readily reveals this information. It includes lists of research on the grounds that results will be published. Straight author or title lists have been excluded. Author (GRA)

N71-21920 Colorado Univ., Boulder.
REMOTE SENSING OF THE MIDLATITUDE IONOSPHERE WITH A NARROW BEAM HIGH FREQUENCY RADAR
Robert Dudley Hunsucker (Ph.D. Thesis) 1969 175 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 70-5857

This investigation has utilized a narrow-beam high-frequency oblique-incidence backscatter sounder, scanning in azimuth and elevation, as a remote sensor of the midlatitude ionosphere. The unique feature of the ITS/ESSA HF radar is its ability to scan simultaneously in azimuth and elevation while being sequentially stepped in frequency. It is possible to step through ten frequencies in the 12 to 25 MHz range during the 12 second scan period. Thus this HF radar has the ability to reveal the spatial and temporal behavior of the irregular-structure of the midlatitude ionosphere over a large area both in azimuth and elevation. Analysis of simultaneous data from the Explorer 20 satellite topside sounder and from the ITS/ESSA HF radar shows no evidence that large and medium scale ionospheric irregularities are field aligned, nor do they extend above the peak of the F-layer. These results apply to the midlatitude region during winter sunspot minimum conditions. Dissert. Abstr.

N71-21925# Naval Postgraduate School, Monterey, Calif.
THE EFFECTS OF OCEAN SURFACE ROUGHNESS ON THE

TRANSMISSION OF SOUND FROM AN AIRBORNE SOURCE
Raymond Allan Helbig (M.S. Thesis) Dec. 1970 119 p refs
(AD-717588) Avail: NTIS CSCL 8/10

Using the research platform FLIP, experiments were conducted to determine the effect of measured ocean surface roughness on transmission of sound from an airborne source into the sea. Signal noise both at the air-water interface and at points in the underwater sound field were recorded using modified AN/SSQ-57 sonobuoys. Ocean wave spectra and rms wave height, sigma, were determined from simultaneous recordings of ocean surface wave height variations. Author (GRA)

N71-21932+ Instituto Geographico y Catastral, Madrid (Spain). Observatorio Central Geofisico.
ANNUAL OF THE GEOMAGNETIC AND AERONOMIC SERVICES FOR 1967 [ANUARIOS DEL SERVICIO DE GEOMAGNETISMO Y AERONOMIA, ANO 1967]
Gonzale Payo Subiza et al 1969 256 p refs In SPANISH
Avail: NTIS

The results of the systematic investigation of the components of the terrestrial magnetic field are presented with graphs of the diurnal variations for several sations. Data for the prominent magnetic activities are tabulated. Also included are magnetograms for the rapid variations in the magnetic field. Transl. by F.O.S.

N71-21936# Universidad Mayor de San Andres, La Paz (Bolivia). Lab. de Fisica Cosmica.
NEUTRON MONITOR: NM-64, CHACALTAYA, BOLIVIA. DATA FOR THE PERIOD MARCH 1969–FEBRUARY 1970, NO. 36 [MONITOR DE NEUTRONES NM-64, CHACALTAYA, BOLIVIA. DATOS CORRESPONDIENTES AL PERIODO MARZO 1969–FEBRERO 1970, CUADERNO NO. 36]
R. Anda, G. R. Mejia, and M. Zubieta May 1970 40 p In SPANISH
Avail: NTIS

Tabulated hourly neutron count, and graphs of the hourly variations are presented. The data were obtained by the NM-64 installed at Chacaltya, Bolivia. Transl. by F.O.S.

N71-21938# Rosenstiel School of Marine and Atmospheric Sciences, Miami, Fla.
MONSOONAL RESPONSE IN THE WESTERN INDIAN OCEAN
Walter Dueing and Karl-Heinz Szekielda Jan. 1971 21 p refs
(Contract N00014-67-A-0201-0013)
(AD-717391; ML-71004) Avail: NTIS CSCL 8/3

Infrared observations from spacecraft are used to investigate the response of the Somali Current to the onset of the Southwest Monsoon. Selected satellite observations from three years were available for this study (Nimbus series 1966, 1969, and 1970). The time-dependent development of horizontal temperature gradients at the sea surface serves as an indicator for the formation of the baroclinic structure of the Somali Current. A comparison is made with the simultaneous development of the southwest component of the monsoon wind. The investigation reveals that the temperature gradients during the early formation stage in all years are directly proportional to the wind speed. The phase lag between the development of wind and temperature gradient is surprisingly short during the buildup of the boundary current, ranging between three and ten days. During the decay period in late summer and fall, the temperature gradients lag 14 to 40 days behind the wind. The observations suggest that two phenomena of different spatial scales play an important role during the formation of the Somali Current. Author (GRA)

N71-21954# Joint Publications Research Service, Washington, D.C.
OCEANOGRAPHY
In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 246 12 Feb. 1971 p 24–30 (See N71-21951 11-30)
Avail: NTIS

Abstracts of news releases, and scientific articles on oceanography are presented. Some abstracts included are: monograph on marine bioluminescence, increasing efficiency of oceanographic expeditions, reflection of light pulses from semi-infinite turbid medium, sound generation in the ocean, carbonates in the upper layer of bottom sediments, and vertical distribution of dissolved organic carbon in sea water. F.O.S.

N71-21955# Joint Publications Research Service, Washington, D.C.
TERRESTRIAL GEOPHYSICS
In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 246 12 Feb. 1971 p 31–37 (See N71-21951 11-30)
Avail: NTIS

Summaries of news releases and abstracts of scientific articles on terrestrial geophysics are presented. Some of the abstracts included are: visit to Tashkent seismic station, use of earthquake waves for geological prospecting, and aerogeodetic method for surveying sea currents. F.O.S.

N71-21956# Joint Publications Research Service, Washington, D.C.
UPPER ATMOSPHERE AND SPACE RESEARCH
In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 246 12 Feb. 1971 p 38–80 (See N71-21951 11-30)
Avail: NTIS

Summaries of news releases and scientific articles on upper atmosphere and space research are presented. Topics for these abstracts include: synoptic maps of stratosphere and mesosphere, notes on the Venera-7 flight, and crew-replacement experiment during Lunokhod-1 operations. F.O.S.

N71-21965+ Scientific Group for Space Research, Athens (Greece).
DATA OF SOLAR-TERRESTRIAL INTEREST, NOVEMBER 1970
D. J. Ilias and D. P. Elias, eds. Nov. 1970 13 p
Avail: NTIS

Short wave propagation and absorption data and presented for SID detection and evaluation of corresponding maximum of solar X-ray bursts. Hourly values of absorption and X-ray data are tabulated for November 1970, along with observations of sunspots and satellites. N.E.N.

N71-21966+ Scientific Group for Space Research, Athens (Greece).
DATA OF SOLAR-TERRESTRIAL INTEREST, JANUARY 1971
D. J. Ili and D. P. Elias, eds. Jan. 1971 20 p refs
Avail: NTIS

Short wave propagation and absorption data are presented for SID detection and evaluation of corresponding maximum of solar X-ray bursts. Hourly values of absorption and X-ray data are tabulated for January 1971, along with observations of sunspots and satellites. N.E.N.

N71-21971# Raff Analytic Study Associates, Inc., Silver Spring, Md.
SPECTRA OF GEOLOGICAL MAGNETIC FLUCTUATIONS Final Report
Julius I. Bowen and Eric L. Sander 30 Oct. 1970 90 p refs
(Contract N00014-67-C-0294)
(AD-717407; FR-70-15) Avail: NTIS CSCL 8/14

The spectrum of geological noise, that portion of the magnetic field fluctuations which is due to buried deposits of magnetized

rocks beneath the sea, has been studied. The power spectra along ten tracks off the U.S. East Coast, part of Project Magnet, were computed from the analog records of magnetic field measurements. An attempt was made to characterize the behavior of the observed spectra simply on the basis of Laplaces equation, the implication being that the spectral density (in logarithmic units) falls off linearly with frequency and the slope of the fall-off is directly proportional to the depth of magnetic deposits. The small data sample examined does in fact appear to be amenable to this analysis but the depth at which the magnetic rocks are buried beneath the ocean bottom must be treated as an adjustable parameter. This is theoretically reasonable there being no reason for this to be a global constant. Furthermore, this effective burial depth appears to apply over sizable geographical regions. Author (GRA)

N71-21985# Institut Royal Meteorologique de Belgique, Brussels.
IONOSPHERIC AND COSMIC RAY OBSERVATIONS Monthly Bulletin, Nov. 1970 [OBSERVATIONS IONOSPHERIQUES ET DU RAYONNEMENT COSMIQUE Bulletin Mensuel, Novembre 1970]
1970 30 p In FRENCH and DUTCH
Avail: NTIS

Results of ionospheric and cosmic ray (neutron component) observations at Dourbes (Belgium) are tabulated for November 1970. ESRO

N71-21986# Institut Royal Meteorologique de Belgique, Brussels.
IONOSPHERIC AND COSMIC RAY OBSERVATIONS Monthly Bulletin, Oct. 1970 [OBSERVATIONS IONOSPHERIQUES ET DU RAYONNEMENT COSMIQUE Bulletin Mensuel, Octobre 1970]
1970 30 p In FRENCH and DUTCH
Avail: NTIS

Results of ionospheric and cosmic ray (neutron component) observations at Dourbes (Belgium) are tabulated for October 1970. ESRO

N71-21989*# Research Triangle Inst., Durham, N.C. Engineering and Environmental Sciences Div.
APPLICATIONS OF AEROSPACE TECHNOLOGY IN AIR POLLUTION CONTROL Semiannual Report, 15 Mar.–30 Sep. 1970
30 Sep. 1970 67 p
(Contract NASw-1950)
(NASA-CR-117469; RTI-EU-564) Avail: NTIS CSCL 04A

Activities in the transfer of aerospace science and technology to applications in air pollution control are summarized including the 26 problems under investigation and their proposed solutions. J.M.

N71-21993# Institut Royal Meteorologique de Belgique, Brussels.
IONOSPHERIC AND COSMIC RAY OBSERVATIONS Monthly Bulletin, Aug. 1970 [OBSERVATIONS IONOSPHERIQUES ET DU RAYONNEMENT COSMIQUE Bulletin Mensuel, Aout 1970]
1970 30 p In FRENCH and DUTCH
Avail: NTIS

Results of ionospheric and cosmic ray (neutron component) observations at Dourbes (Belgium) are tabulated for August 1970. ESRO

N71-21994# Institut Royal Meteorologique de Belgique, Brussels.
IONOSPHERIC AND COSMIC RAY OBSERVATIONS Monthly Bulletin, Sep. 1970 [OBSERVATIONS IONOSPHERIQUES ET DU RAYONNEMENT COSMIQUE Bulletin Mensuel, Septembre 1970]
1970 30 p In FRENCH and DUTCH
Avail: NTIS

Results of ionospheric and cosmic ray (neutron component) observations at Dourbes (Belgium) are tabulated for September 1970. ESRO

N71-22045# Lockheed Missiles and Space Co., Palo Alto, Calif.
CHARGED PARTICLES AND TEMPERATURE IN THE IONOSPHERE
V. S. Agalakov et al 1970 7 p Transl. into ENGLISH from Priroda (USSR), no. 11, 1970 p 69–72
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

Rocket and ground observations of the ionosphere by radio wave backscattering are described and used to determine electron concentrations and charged particle temperatures. Results indicate that ionospheric electron distribution depends on solar activity, the time of year, the time of day, geographic and geomagnetic coordinates, etc. Electron temperatures can differ substantially from the temperatures of neutral particles and ions. Ionospheric temperature exhibits annual, diurnal, and spatial fluctuations. G.G.

N71-22047# Weapons Research Establishment, Salisbury (Australia).
IONOSPHERIC DATA FOR FEBRUARY 1970 FROM SALISBURY, SOUTH AUSTRALIA
Jul. 1970 27 p refs
SAD-1970/2(S))Avail: NTIS

Tables of the hourly values of the customary ionospheric parameters are given for the station at Salisbury for February 1970. Author

N71-22052# Joint Publications Research Service, Washington, D.C.
OCEANOGRAPHY
In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 247 1 Mar. 1971 p 16–30 (See N71-22049 11-30)
Avail: NTIS

Soviet news releases are presented on Soviet-Cuban oceanographic research; Dmitriy Mendeleyev leaving on expedition in Pacific; research vessel, Vityaz, visits New Zealand; organization for promotion of cooperation in underwater exploration; some unsolved problems in International Marine Law; possibilities of deep water manipulator, and seismoacoustic profiling at sea. Two books on underwater apparatus are reviewed. Abstracts on various oceanographic literature are also included. J.A.M.

N71-22053# Joint Publications Research Service, Washington, D.C.
TERRESTRIAL GEOPHYSICS
In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 247 1 Mar. 1971 p 31–40 (See N71-22049 11-30)
Avail: NTIS

A light weight seismic station developed for remote recording is briefly discussed, along with vertical derivative determination of gravity potential, using a horizontal gradientometer. Measuring geomagnetic components from moving platforms and seismic station recordings at Stocki on 27 January 1971 are examined. Abstracts on various geophysical literature are also presented, including seismic studies in coastal regions, crustal structure investigations from surface wave dispersion, and absorption and resistivity of rocks in ore deposits. J.A.M.

N71-22054# Joint Publications Research Service, Washington, D.C.
UPPER ATMOSPHERE AND SPACE RESEARCH
In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 247 1 Mar. 1971 p 41–59 (See N71-22049 11-30)
Avail: NTIS

The third working day of operation for the Lunakhod is reviewed and analyzed, including chemical analysis of soil samples and X-ray telescopic recordings of cosmic ray flux. The launching of the Cosmos 393 is announced. Remote sensing applied to geological data acquisition and to increasing the efficiency of the fishing industry is briefly discussed. Abstracts on various atmospheric and aerospace literature are also given. J.A.M.

N71-22055# Joint Publications Research Service, Washington, D.C.

ATMOSPHERIC STUDIES AT CHEMICAL ENTERPRISES

9 Mar. 1971 170 p refs Transl. into ENGLISH from Zh. Uses. Khim. Obshchestva im. D. I. Mendeleeva (Leningrad), v. 15, no. 5, 1970 p 482–560

(JPRS-52566) Avail: NTIS

CONTENTS:

1. INDUSTRIAL POLLUTION OF THE ATMOSPHERE O. V. Chebotarev p 1–22 refs (See N71-22056 11-13)

2. PHOTOELECTRIC GAS ANALYZERS G. I. Kryukov et al p 23–38 refs (See N71-22057 11-14)

3. ELECTROCHEMICAL GAS ANALYZERS FOR ANALYZING TOXIC AGENTS IN THE AIR V. Z. Alperin et al p 39–52 refs (See N71-22058 11-14)

4. POSSIBILITIES OF LUMINESCENT ANALYSIS OF INDUSTRIAL AIR POLLUTION E. T. Gaynullina et al p 53–67 refs (See N71-22059 11-24)

5. IONIZATION METHODS OF MONITORING AIR POLLUTION G. I. Bogorad et al p 68–80 refs (See N71-22060 11-13)

6. COLORIMETRIC OXIDATION REDUCTION REACTIONS IN ANALYZING THE AIR OF INDUSTRIAL ENTERPRISES I. A. Lyamin p 81–101 refs (See N71-22061 11-06)

7. KINETIC METHODS OF ANALYZING ORGANIC COMPOUNDS A. A. Druzhinin p 102–118 refs (See N71-22062 11-06)

8. APPLICATION OF THE METHOD OF INFRARED ABSORPTION IN ANALYZING MICROADMIXTURES OF HARMFUL AGENTS IN THE AIR I. V. Korablev et al p 119–130 refs (See N71-22063 11-14)

9. IDEAS AND METHODS OF CYBERNETICS: PROCEDURAL BASE FOR DEVELOPMENT OF INDUSTRIAL INDICATING DEVICES S. K. Bordakov p 131–152 refs (See N71-22064 11-10)

10. BIONICS AS APPLIED TO ANALYTICAL RESEARCH E. T. Gaynullina p 153–169 refs (See N71-22065 11-05)

N71-22056# Joint Publications Research Service, Washington, D.C.

INDUSTRIAL POLLUTION OF THE ATMOSPHERE

O. V. Chebotarev *In its* Atmospheric Studies at Chem. Enterprises 9 Mar. 1971 p 1–22 refs (See N71-22055 11-13)

Avail: NTIS

The industrial pollution problem is surveyed centering on sources of pollution, toxicity and control, and techniques and equipment for monitoring and sampling the air. Gas signal analysis methods are also discussed. E.C.

N71-22060# Joint Publications Research Service, Washington, D.C.

IONIZATION METHODS OF MONITORING AIR POLLUTION

G. I. Bogorad et al *In its* Atmospheric Studies at Chem. Enterprises 9 Mar. 1971 p 68–80 refs (See N71-22055 11-13)

Avail: NTIS

Aerosol and flame ionization techniques for air sampling gas analysis are discussed. Detectors and analyzers for applying these ionization methods are described. E.C.

N71-22066*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.

ANALYSIS OF SEVERAL RELATIONS AMONG ATMOSPHERIC STATISTICS

R. A. Minzner and P. Morgenstern Washington Mar. 1971 40 p refs

(NASA-TR-R-365; C-113) Avail: NTIS CSCL 04A

A statistical equation relating the mean values of pressure, temperature, and density in a gas-law-like expression includes (in addition to the regular gas-law-like terms) a correction term proportional to the covariance between density and temperature. The application of the data from a set of 437 rocket soundings showed the value of the covariance term to be generally in the range of + or − 1.0 percent of the mean pressure for altitudes of 30 to 60 km. The covariance was largest at the greater altitudes, in arctic latitudes, and during winter months. The application of the same data sets to another statistical equation relating the partial derivative of the standard deviation of pressure with respect to altitude to the standard deviation of density in a form suggestive of the hydrostatic equation yielded very poor agreement, undoubtedly owing to large uncertainties in the observed values of the partial differential. An integral form of the same equation, however, served to predict the observed data rather well. Author

N71-22067# National Physical Lab., New Delhi (India). Radio Propagation Unit.

IONOSPHERIC PREDICTIONS FOR JANUARY 1971

Oct. 1970 4 p

(RRC-B172) Avail: NTIS

Graphs of predicted median foF2 values and predicted median MUF(4000)F2 values are presented, along with a nomogram for transforming F2-zero-MUF and F2-4000-MUF to equivalent maximum usable frequencies at intermediate transmission distances. Author

N71-22125# Stanford Univ., Calif. Electronics Labs.

A CONTINUED STUDY OF THE MECHANISMS OF EMISSION GENERATION AND WHISTLER PROPAGATION

Final Report, 1 Oct. 1969 - 30 Sep. 1970

Robert A. Helliwell Dec. 1970 23 p refs

(Grant AF-AFOSR-1840-70)

(AD-717781; AFOSR-70-2985TR) Avail: NTIS CSCL 4/1

During the last year the following results were obtained. The response of a model plasma to a triggering wave was calculated and it was found that there is a phase memory effect. Progress in the location of whistler ducts has been very encouraging. Completion of the direction finding technique initiated during this period of research should add an important new tool for the general study of magnetospheric electromagnetic phenomena. Possible practical applications of this work include diagnostics of the magnetosphere and problems involving communication and navigation aids at very low frequencies. GRA

N71-22152# Louisiana State Univ., Baton Rouge. Coastal Studies Inst.

OREGON AND NORTHERN CALIFORNIA COASTAL RECONNAISSANCE

Richard J. Russell 30 Aug. 1970 34 p refs

(Contract N00014-69-A-0211-0003)

(AD-717359; TR-86) Avail: NTIS CSCL 8/6

Coastal reconnaissance during April and early May, 1970, in Oregon and northern California had the main objective of studyng marine erosional attack resulting from contrasts above and below the water table. Retreat of sea cliffs in the zone of aeration above ground water level is associated with the development of platforms of marine abrasion toward the top of the underlying zone of cementation, where rock is more durable. Pseudo-beach rock in sandy beaches consists of bedrock abraded along the zone of water

table fluctuation. Some general comments on coastal landforms are included and some applications are indicated for users of small boats. A new terms, subswash zone, is introduced. Author (GRA)

N71-22153# Massachusetts Inst. of Tech., Cambridge. Dept. of Earth and Planetary Sciences.
EXPERIMENTAL STUDY OF INTERNAL GRAVITY WAVES OVER A SLOPE
David A. Cacchione (Ph.D. Thesis) Nov. 1970 253 p refs Prepared in cooperation with Woods Hole Oceanographic Institution (Contract Nonr-1841(74))
(AD-717367; Rept-70-6) Avail: NTIS CSCL 8/3

Propagation of internal gravity waves over a slope in a fluid with constant Brunt-Vaisala frequency was studied in a wave tank. Wave motion in the fluid interior was measured with conductivity probes, and in the boundary layer, with dye streaks and neutrally buoyant particles. Outside the breaking zone, the amplitude and horizontal wave number of high-frequency waves increase linearly with decreasing depth; this is in agreement with existing linear, inviscid solutions. Well upslope, a zone of breaking or runup is produced by the high-frequency waves. If the wave characteristics are closely parallel to the bottom slope, upslope propagation of low-frequency waves produces a line of regularly spaced vortices along the slope, which slowly penetrate into the fluid interior; mixing in these vortices sets up thin horizontal laminae that are more nearly homogeneous than adjacent layers. A criterion for incipient motion of bottom sediment under shoaling internal waves was developed using available theoretical solutions for velocity in the viscous boundary layer, found to be valid for certain experimental conditions. Author (GRA)

N71-22154*# Colorado Univ., Boulder. Lab. for Atmospheric and Space Physics.
MARINER 6 AND 7 ULTRAVIOLET SPECTROMETER EXPERIMENT: UPPER ATMOSPHERE DATA
C. A. Barth, C. W. Hord, J. B. Pearce, K. K. Kelly, G. P. Anderson et al Jan. 1971 77 p refs
(Grant NGR-06-003-127)
(NASA-CR-117756) Avail: NTIS CSCL 04A

Mariner 6 and 7 observations of the Mars upper atmosphere show the ultraviolet emission spectrum to consist of the CO2(+) A-X and B-X bands, the CO a-X and A-X bands, the CO(+) B-X bands, the CI 1561 and 1657 A lines, the OI 1304, 1356, and 2972 A lines, and the HI 1216 A line. Laboratory measurements and theoretical calculations show that the CO2(+) band systems are produced by the combination of photoionization excitation of CO2 and fluorescent scattering of CO2(+). An analysis of the vibrational populations of the CO Cameron bands shows that they may be produced from photon or electron dissociative excitation of CO3. The vibrational distribution of the CO fourth positive bands is the same in the Mars spectrum as in a laboratory CO2 dissociative excitation spectrum except for those bands that are self-absorbed by CO in the Mars atmosphere. Author

N71-22231# Naval Postgraduate School, Monterey, Calif.
ORIGIN OF SWELL RECORDED AT MONTEREY, CALIFORNIA
Wayne J. Braunstein (M.S. Thesis) Sep. 1970 78 p refs
(AD-717611) Avail: NTIS CSCL 8/3

Selected swell wave records from Monterey, California and the associated weather maps were analyzed to determine at what stage in the storm history the peak energy in the swell trains was produced. The apparent origin of the swell, derived by frequency-time analysis of the wave records, was found to lie within the fetch determined from the weather maps, and to occur during the stage in the storm history when the fetch velocity was rapidly decreasing. The group velocity of the peak energy swell was found to equal the fetch velocity at the time of swell origin, a condition suitable for the generation of large wave energy because of a long effective wind duration. By assuming fully arisen seas at the apparent swell source, an average value of the ratio of surface to geostrophic wind speed of 0.77 was obtained. This value was derived from surface winds obtained from the wave data and geostrophic winds obtained from the weather maps. These results confirm the assumption that the peak energy swell was generated in fully arisen seas, and that no shift occurred in the peak swell period in shallow water off Monterey. Author (GRA)

N71-22245# Geological Survey, Washington, D.C. Water Resources Div.
REMOTE SENSING BIBLIOGRAPHY FOR EARTH RESOURCES, 1966 – 1967
Rita K. Llaverias May 1970 136 p refs *Its* Interagency Rept. No. 189
(PB-192863; USGS-WD-70-001) Avail: NTIS CSCL 05C

The second in a series of bibliographies on remote sensing of earth resources applications is presented. The subject matter coverage is extended from the earlier more restricted area of hydrology to the broader field of earth resources, but the emphasis on water resources applications remains. Citations of literature appearing in 1966-1967 are presented from such fields as agriculture, forestry, geography, geology, hydrology, meteorology, oceanology, range management, and urban planning, to the extent that they relate to water resources. For the 412 citations, indexes are provided for personal and corporate authors; the subject term index contains three descriptors for each item. Author (GRA)

N71-22259# New Mexico Inst. of Mining and Technology, Socorro.
A FOURIER ANALYSIS OF THE NEAR FIELD VELOCITIES RESULTING FROM A SIMULATED BILATERAL SHEAR FRACTURE Final Technical Report, 18 Nov. 1969 – 17 Nov. 1970
Merle E. Hanson, Allan R. Stanford, and Ronald J. Shaffer 15 Jan. 1971 28 p refs
(Contract F44620-70-C-0055; ARPA Order 1031)
(AD-717759; AFOSR-TR-71-0082) Avail: NTIS CSCL 8/11

The data from a numerically simulated dynamic bilateral shear fracture were analyzed using Fourier spectral techniques. The holes in the amplitude spectrums of the velocity data in the near field are compared with an analytically calculated source time. The periods resulting from the holes in the amplitude spectrum correlate with the source time calculated from analytical considerations. The analysis of the near field velocities at an observation point can show at least part of the characteristics of the finite source. Author (GRA)

N71-22297# Ohio Univ., Athens. Dept. of Physics.
MANY BODY PHENOMENA APPLIED TO SOLID STATE ELECTRONIC MATERIALS Final Report
Ernst Breitenberger Dec. 1970 9 p refs
(Grant AF-AFOSR-1498-68)
(AD-717758; AFOSR-70-2940TR) Avail: NTIS CSCL 20/12

In five-and-a-half years of work under this grant, projects were successfully concluded in ferro- and antiferromagnetism, phase transitions, parametric amplification, electrical conductivity and nuclear models; notable mathematical advances were made by the introduction of connected-diagram techniques and by the combination of techniques from many-body theory and from statistical mechanics; and fundamental contributions were made to the understanding of orbital instabilities and to the Darwin interaction. Author (GRA)

N71-22343# Boston Coll., Chestnut Hill, Mass.
RESEARCH DIRECTED TOWARD THE COLLECTION, REDUCTION AND EVALUATION OF GEOMAGNETIC FIELD

DATA AND ELECTRIC FIELD PHENOMENA, ATMOSPHERIC AND TERRESTRIAL Final Report, 1 Nov. 1967 - 31 Oct. 1970

Peter D. Prevett 9 Nov. 1970 63 p refs
(Contract F19628-68-C-0100)
(AD-717779; AFCRL-70-0656) Avail: NTIS CSCL 8/14

The report deals with the study of the earths geomagnetic field at both low and high altitudes. Part of the study was implemented using sub-orbital rocket payloads which contained airborne magnetometers, electric field devices, and a particle counter. The data was FM multiplexed over a telemetry link to the ground station where it was recorded in analog form on magnetic tape. Author (GRA)

N71-22357# Air Force Cambridge Research Labs., Bedford, Mass.

A HYDROSTATIC APPROXIMATION FOR THE FLATTENING OF THE PLANETS

Harry E. Moses and Antonio F. Quesada 2 Dec. 1970 15 p refs
(AD-717687; AFCRL-70-0668; AFCRL-AFSG-228) Avail: NTIS CSCL 3/1

Geodesy plays an important role in determining satellite orbits and paths of chemical releases. A simple hydrostatic model gives the correct flattening ratio of the six oblate planets within a factor of 2.05. A conjecture is hazarded as to why the agreement is not even better. Author (GRA)

N71-22358# Massachusetts Inst. of Tech., Cambridge. Dept. of Meteorology.

A NUMERICAL MODEL OF A CONVECTIVE CELL DRIVEN BY NONUNIFORM HORIZONTAL HEATING

John F. Festa (M.S. Thesis) Nov. 1970 91 p refs
(Contract Nonr-1841(74); Grant NSF GP-5053)
(AD-717670; GFD/70-4; Rept-70-7) Avail: NTIS CSCL 8/3

A numerical model of thermal convection for a two-dimensional laminar, non-linear, non-rotating, incompressible, viscous fluid contained in a rectangle and heated non-uniformly from below is investigated. Two studies are made, one for a stress free bottom boundary and the other for a constant applied stress along the bottom. The Boussinesq equations are integrated numerically by means of the explicit scheme of DuFort and Frankel (1953) and in each case the top and side boundaries are both insulating and rigid. In the first study the dependence of the cellular convective motion and isotherms upon the Prandtl number and the horizontal Rayleigh number, Ra, is examined. A single asymmetric convective cell develops as the Rayleigh number is increased. The asymmetry and intensity of the circulation increases markedly with increasing horizontal Rayleigh number but respond slightly to changes in the Prandtl number. The bottom boundary layer thickness is also examined and is found to decrease as the Rayleigh number increases. In the second study, calculations are presented for a single Rayleigh number and Prandtl number and a moderate range in applied stress. The stress is applied in opposition to the thermal driving. As the stress increases, the thermal circulation weakens and the opposing circulation becomes stronger. The increase in stress results in a change from a thermal to a dual, containing both thermal and stress driven circulations of the same magnitude, to a stress driven circulation. Author (GRA)

N71-22397+ Kakioka Magnetic Observatory (Japan).

GEOELECTRIC OBSERVATIONS AT KAKIOKA, MEMAMBETSU, AND KANOYA IN JAPAN IN 1965

1970 54 p refs
(Rept-71) Avail: NTIS

The results of geoelectric observations made in 1965 at the Kakioka Magnetic Observatory and at two branch magnetic observatories, Memambetsu and Kanoya, are presented. The geographic and geomagnetic coordinates and the item of geoelectric observations of these observatories are described. Hourly values of atmospheric and earth-current potential gradients at Kakioka are tabulated. Author

N71-22404# Kakioka Magnetic Observatory (Japan).

GEOMAGNETIC OBSERVATIONS AT KAKIOKA, JAPAN IN 1968

1970 120 p refs
(Rept-74) Avail: NTIS

Results of 1968 geomagnetic observations recorded in Kakioka, Japan are presented. Hourly values of vertical and horizontal intensity and declination are tabulated as well as mean hourly values for each element and north and west components for all, calm, and disturbed days; three-hour-range indices and character figures; and general characteristics of principle magnetic disturbances. Reproductions of magnetograms are also shown. J.M.

N71-22438+ Kakioka Magnetic Observatory (Japan).

REPORT OF THE KAKIOKA MAGNETIC OBSERVATORY. GEOELECTRICITY: KAKIOKA, MEMAMBETSU, KANOYA, 1966

1970 57 p refs
(Rept-72) Avail: NTIS

Geoelectric observations carried out at the Kakioka, Memambetsu, and Kanoya observatories of Japan are presented in tabular form. The geographic, geomagnetic coordinates, atmospheric electrical potential, and earth currents are included. Author

N71-22445# Weapons Research Establishment, Salisbury (Australia).

IONOSPHERIC DATA FOR JANUARY 1970 FROM SALISBURY, SOUTH AUSTRALIA

Jul. 1970 28 p
(WRE-SAD-1970/1(S)) Avail: NTIS

Tables of the hourly values of the customary ionospheric parameters are given for the station at Salisbury for January 1970. Author

N71-22446# Kakioka Magnetic Observatory (Japan).

REPORT OF THE KAKIOKA MAGNETIC OBSERVATORY: GEOMAGNETISM, KANOYA, 1967

1970 63 p refs
(Rept-67) Avail: NTIS

Regular absolute observations of each magnetic element were made once or twice a week, using the MO-1 magnetometer in the absolute house. The probable errors of observations by the MO-1 and the comparative results made in 1967 between the MO-1 and the A-56 at Kakioka are presented. Two sets of variometers were operated in the two houses, including horizontal intensity, declination, and vertical intensity variometers. Sensitivity determinations for each variometer were made twice a month. Base line values and hourly values were tabulated. Geomagnetic indices K and C, general character of principal magnetic disturbances, and magnetogram reproductions were also examined. J.A.M.

N71-22449# Hawaii Inst. of Geophysics, Honolulu.

[STUDIES ON OCEAN CIRCULATION, GEOPHYSICAL AND GEOLOGICAL INVESTIGATIONS IN AREAS OF ANOMALOUS GRAVITY, AND CHEMICAL OCEANOGRAPHY] Annual Progress Report, 1 Jan. - 31 Jul. 1970

George P. Woollard, Klaus Wyrtki, G. H. Sutton, and Keith Chave 30 Dec. 1970 110 p refs
(Contract N00014-70-A-0016-0001)
(AD-717664; HIG-70-27) Avail: NTIS CSCL 8/10

The report covers operations and results obtained for the period January 1 through December 31, 1970 between the Hawaii Institute of Geophysics, University of Hawaii and the Ocean

Science and Technology Branch of the Office of Naval Research. The report is subdivided on the basis of the three tasks covered by subject contract with a separate report for each task prepared by the respective principal investigators. The report for Task 2 also includes the cruise reports for Legs 1A, 1B, 2, and 3 of the 1970 cruise of the R/V MAHI which was at sea nine months and did not return to Honolulu until the middle of December. This section of the progress report also contains an appendix giving abstracts of papers in preparation under this task. The reporting period was extended to 12 months (to December 30, 1970) in order to include all field operations done on the 1970 cruise of the R/V MAHI. The operational areas covered by the cruise reports are the Line Islands Ridge, the Phoenix Islands, and the Fiji Plateau - New Hebrides area to Rabaul, New Guinea on to Guam.
Author (GRA)

N71-22478*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
EARTH PHYSICS DATA MANAGEMENT STUDY Final Report
Jan. 1971 72 p refs
(Grant NGR-09-015-107)
(NASA-CR-117842; SAO-101-15) Avail: NTIS CSCL 08G

A system to assemble and transcribe, in computer accessible form, an appropriate selection of information to support an earth physics program is investigated. The problems of data management and organization of a computer system for such a program are discussed. Conclusions concerning practicality and advisability of the system are given. Recommendations are also given for next steps in organizing the system.
E.H.W.

N71-22518# Danish Meteorological Inst., Charlottenlund.
THE ICE CONDITIONS IN THE GREENLAND WATERS, 1963
1970 78 p refs
(ISBH-87-7478-005-0) Avail: NTIS

Problems in aerial reconnaissance and radar scanning of ice flows around Greenland are reviewed, as well as the polar ice measurement comparison between the east and west coast flows. Measurements of individual coastal stations at particular times are also presented, along with charts showing the seasonal ice movement.
J.A.M.

N71-22533*# National Oceanic and Atmospheric Administration, Boulder, Colo. Environmental Research Labs.
DEVELOPMENT OF A SYSTEM FOR REMOTE SENSING OF IONOSPHERIC MOTIONS AND MICROSTRUCTURE: THE KINESONDE IN FRANCE, 1970
J. W. Wright, W. Plywaski, and L. S. Fedor Jan. 1971 111 p refs
(NASA Order W-13039; Grant NATO-413; NOAA Proj. 251405630)
(NASA-CR-117837; NOAA-ERLTM-OD-6) Avail: NTIS CSCL 04A

A program of investigations is reported with goals that include: (1) development of what is considered to be a suitably competent measurement system, the digitized multifrequency complex-amplitude Kinesonde; (2) refinement of a statistically-rigorous procedure for correlation analysis of spaced-sensor measurements; and (3) completion of several series of simulated and actual experiments. In particular, the experimental program was conducted to compare E-region Kinesonde measurements with time-dependent neutral wind profiles obtained by the meteor wind technique, and over a broader range of altitudes extending into the F region, to compare the Kinesonde results against Thomson scatter measurements of meridional ion drift. A few early comparisons with meteor winds suggest that the Kinesonde technique, applied within the daytime E-region, observed the neutral wind profile directly; the standard point source correction appears valid.
Author

N71-22542# Kakioka Magnetic Observatory (Japan)
REPORT OF THE KAKIOKA MAGNETIC OBSERVATORY: GEOELECTRICITY, KAKIOKA, MEMAMBETSU, KANOYA, 1967
1970 56 p refs
(Rept-73) Avail: NTIS

The results are presented of geoelectric observations made in 1967 at the Kakioka Magnetic Observatory and the summary results at two branch magnetic observatories; Memambetsu and Kanoya. Two classes of geoelectric observations are reported; atmospheric electric potential gradient, and earth-current potential gradient. The atmospheric electric potential gradient results include tables of: (1) hourly values at Kakioka for all days, (2) mean hourly values at Kakioka for each month and season for undisturbed hours, and (3) mean hourly values at Kakioka and Memambetsu for each month and season for calm days. The earth-current potential gradient results include tables of: (1) hourly values at Kakioka of E-W and N-S components for all days, and (2) mean diurnal variations of each component for all days at Kakioka, and for selected calm and distributed days at Kakioka, Memambetsu, and Kanoya.
D.L.G.

N71-22543# Kakioka Magnetic Observatory (Japan).
REPORT OF THE KAKIOKA MAGNETIC OBSERVATORY: GEOMAGNETISM, MEMAMBETSU, 1967
1970 68 p refs
(Rept-66) Avail: NTIS

The geomagnetic observations reported include the following: (1) absolute observations of magnetic elements, (2) variometer data, (3) scale values, (4) base-line values, (5) hourly values and associated mean values, (6) geomagnetic indices K and C, (7) general character of principal magnetic disturbances, and (8) reproductions of magnetograms.
D.L.G.

N71-22544# Danish Meteorological Inst., Charlottenlund.
THE WMO SEA ICE NOMENCLATURE: DANISH EDITION [WMO ISNOMENKLATUR: DANSK UDGAVE]
1969 29 p In DANISH; ENGLISH summary
(Rept-22) Avail: NTIS

A Danish translation is presented of sea ice nomenclature as approved by the World Meteorological Organization (WMO) in 1968. The material includes: a key in Danish, leading to all WMO terms in Danish; (2) all WMO terms in Danish and English with a full description in Danish of each term; (3) Danish terms arranged in alphabetical order with the systematical WMO number of each term; and (4) an English alphabetical index of WMO terms with the WMO numbers and the Danish terms added.
D.L.G.

N71-22592# Air Force Cambridge Research Labs., Bedford, Mass. Ionospheric Physics Lab.
AREAL MAPPING: A PRELIMINARY ASSESSMENT OF ITS APPLICABILITY TO THE IONOSPHERE
Charles M. Rush and Robert E. Cookingham 2 Dec. 1970 15 p *Its* Environ. Res. Papers No. 338
(AD-717683; AFCRL-70-0670) Avail: NTIS CSCL 4/1

The mapping of ionospheric parameters for the purpose of extending and extrapolating observations is studied. It is found that a relatively simple contouring program can be used to specify the ionosphere in the lower regions that are under strict solar control. Using electron density data representative of various ionospheric stations in North America, it is seen that the shape of the generated contours for the F region depend upon the location of the various stations. These results seem to imply the need for more sophisticated methods of synoptic representation of the upper level ionosphere.
Author (GRA)

N71-22685# Joint Publications Research Service, Washington, D.C.
OCEANOGRAPHY

In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 248 16 Mar. 1971 p 11–19 (See N71-22682 11-30)
Avail: NTIS

Ocean floor structure, seismic sounding at sea, and other oceanographic studies are briefly reported. Seismic studies were made of the shelf off Sakhalin and the Mediterranean floor, and developments in seismic prospecting are reviewed. Air photographs of the Sakhalin shelf, acousting sounding of the Indian Ocean floor, coastal marine deposits, geosynclinal processes in the ocean, air flow structure over water, and maringe gravimeters are described. N.E.N.

N71-22686# Joint Publications Research Service, Washington, D.C.
TERRESTRIAL GEOPHYSICS
In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 248 16 Mar. 1970 p 20–25 refs (See N71-22682 11-30)
Avail: NTIS

Abstracted data on geomagnetic investigations are presented. Drift of the geomagnetic field across the Atlantic Ocean, the geomagnetic field as a gamma quanta source, and geomagnetic storms are described. Optical filtering during marine gravimetric surveys and the effect of tilts on variometer readings are also mentioned. N.E.N.

N71-22689# Air Force Cambridge Research Labs., Bedford, Mass.
OPTICAL OBSERVATIONS OF CHEMICAL RELEASES IN THE UPPER ATMOSPHERE DURING 1969, WITH DESCRIPTION OF INSTRUMENT USED FOR DAYTIME VAPOR-TRAIL TRACKING
Gordon T. Best 26 Oct. 1970 35 p refs
(AD-717696; AFCRL-70-0692; AFCRL-AFSIG-227) Avail: NTIS CSCL 4/1

During 1969, a number of rocket payloads flown by AFCRL released clouds of chemical vapor, which were measured by triangulation and spectroscopy. This report discusses the results of spectroscopic measurements made on barium clouds and the spectrum of the luminous cloud produced by a release of diborane. A tracking instrument for detecting high-altitude vapor trails during the day is also described, together with the results of a successful field test. The results of these studies are relevant to current Air Force needs in the areas of electromagnetic wave propagation through a disturbed medium, accurate prediction of satellite orbits, and prediction of motion of nuclear debris. Author (GRA)

N71-22692# Air Force Cambridge Research Labs., Bedford, Mass.
PHOTOGRAPHIC STUDIES OF BARIUM RELEASES
Gordon T. Best, Charles A. Forsberg, Thomas M. Noel, and Norman W. Rosenberg 12 Nov. 1970 21 p refs
(AD-717722; AFCRL-70-0687; AFCRL-ERP-341) Avail: NTIS CSCL 4/1

Photography of barium releases was performed by AFCRL from two sites, the primary purposes being to obtain quantative data on peak and integrated intensities and to study the spatial structure and dynamics of the releases by means of stereo techniques. High-speed photography of the release phase was also performed, and a preliminary analysis of the initial expansion mechanism is given. Sample photographs of the releases showing several features of interest are presented. Author (GRA)

N71-22693# Air Force Cambridge Research Labs., Bedford, Mass.
GLOBAL MORPHOLOGY OF IONOSPHERIC SCINTILLATIONS
Jules Aarons, Herbert E. Whitney, and Richard S. Allen 16 Oct. 1970 41 p refs
(AD-717694; AFCRL-70-0672; AFCRL-ERP-339) Avail: NTIS CSCL 4/1

Amplitude fluctuations produced by small irregularities in electron density in the F-layer of the ionosphere (at 300 to 400 km height) can be a problem to communication and navigation systems in the VHF-UHF range. Recent measurements, primarily by AFCRL, are shown with emphasis on results at high and equatorial latitudes. At high latitudes an irregularity region exists whose lower boundary reaches 57 degrees invariant latitude near midnight. During magnetic storms the boundary descends to lower latitudes and the fading becomes deeper. Over the polar cap scintillations are somewhat diminished. When observing synchronous satellites through the irregularity region, deep and fast fading is frequently seen, with fade rates to one per second. Irregularities produce deep scintillations in the VHF range plus or minus 15 degrees from the geomagnetic equator. In equatorial regions maximum occurrence of high level scintillations takes place between 2100 and 2400 local time during the equinoxes; a minimum occurrence is observed during the solstices. When the sunspot number decreases, the equatorial irregularity region spreads and becomes larger. The data for various latitudes have been placed in statistical form, that is, distribution of amplitudes for 15-min samples as well as for periods of 1 yr and longer. Author (GRA)

N71-22698# Air Force Cambridge Research Labs., Bedford, Mass.
SPECTROSCOPIC STUDIES OF BARIUM RELEASES
Gordon T. Best and Norman W. Rosenberg 12 Nov. 1970 21 p refs
(AD-717695; AFCRL-70-0724; AFCRL-ERP-345) Avail: NTIS CSCL 4/1

Optical observations following the release of barium vapor at high altitudes can be described in terms of three phases. The first, lasting of the order of a second, is the initial release and expansion of a neutral barium cloud. The second is the ionization phase that can take from 3 to 100 sec, depending on release altitude and size. The remaining history is characterized by the development of striations in the ion cloud and of a tail joining the ion and neutral clouds. Observations of each of the above phases with various optical instruments showed the ionization mechanism to be via metastable levels, and experiments were conducted which led to a more detailed description of the processes involved. Author (GRA)

N71-22758 Columbia Univ., New York.
POLARIZATION STUDIES OF GEOMAGNETIC RAPID VARIATIONS
John Lawrence Chute, Jr. (Ph.D. Thesis) 1969 111 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 70-6949

Vector characteristics of short period geomagnetic time variations were investigated by analyzing component measurements of the rapid variation field. A preliminary study, based on measurements made with a five station array of cored-coil variometers, was undertaken to define the problem and to gain experience in the analysis of three component magnetic data. A measuring system consisting of rubidium and fluxgate magnetometers was designed and constructed. The system was capable of measuring three orthogonal components of the strength of the rapid variation field, and included provision for continuous digital recording. A seventeen day field program consisting of continuous simultaneous recording at three sites was completed in September, 1966. Approximately four hundred hours of high quality data was obtained for each site. Polarization characteristics for the rapid variation field were derived using an analysis technique based on cross correlation of component measurements. Dissert Abstr.

N71-22772*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A CURSORY EXAMINATION OF THE SENSITIVITY OF THE TROPOSPHERIC RANGE AND DOPPLER EFFECTS TO THE SHAPE OF THE REFRACTIVITY PROFILE

L. F. Miller, V. J. Ondrasik, and C. C. Chao *In its* The Deep Space Network, Vol. 1 15 Feb. 1971 p 22–30 refs (See N71-22766 11-30)
Avail: NTIS CSCL 03B

The different shapes that refractivity profiles may assume during a year are examined. The examination covered how sensitive the mapping of the zenith range effect down to lower elevation angles is to the shape of the refractivity profile, assuming the troposphere to be spherically symmetric with respect to the center of the earth. A ray tracing technique is used for the investigation. Author

N71-22801# Israel Program fo Scientific Translations, Ltd., Jerusalem.
PROBLEMS OF THE ARCTIC AND THE ANTARCTIC
A. F. Treshnikov, ed. 1970 531 p refs Transl. into ENGLISH of the book 'Problemy Arktiki i Antarktiki' Leningrad, Gidrometeorologicheskoe Izdatelstvo, 1968–1969 531 p Sponsored by NSF *Its* Issues 29-32
(TT-70-50017) Copyright. Avail: NTIS HC$6.00/MF$0.95

This document covers a wide variety of Soviet scientific research related to problems peculiar to the Arctic and Antarctic regions. For individual titles, see N71-22802 through N71-22868. A.L

N71-22802# Israel Program for Scientific Translations, Ltd., Jerusalem.
RADIATION REGIME OF THE CENTRAL ARCTIC BASIN
N. T. Chernigovskii *In its* Probl. of the Arctic and the Antarctic 1970 p 3–11 refs Presented at Intern. Symp. on Polar Meteorology, Geneva, 5–9 Sep. 1966 (See N71-22801 11-13)
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Radiation measurement data gathered by Soviet NP-2 through NP-13 drifting stations during 1950 - 1964 and the U.S. T3 Alpha and Bravo drifting stations during 1957 - 1959 are presented in tabular form. A.L

N71-22803# Israel Program for Scientific Translations, Ltd., Jerusalem.
THE POSSIBLE CAUSE OF WATER EXCHANGE VARIATIONS BETWEEN THE ARCTIC AND ATLANTIC OCEANS
V. S. Antonov *In its* Probl. of the Arctic and the Antarctic 1970 p 12–18 refs (See N71-22801 11-13)
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A characteristic feature of water exchange between the Arctic and Atlantic oceans is in the considerable variation in the outflow of arctic waters and ice and inflow of warm Atlantic waters to the Arctic Ocean. Determinations of the volume of water participating in the water exchange between the two oceans in the northern hemisphere show extreme variation. The discrepancies in the quantitative determinations of water exchange are due to inadequate knowledge of the problem because of insufficient observation data. The program of water exchange between the two oceans is the key to ice cover forecasts for arctic seas. The possible causes of exchange variations, and their effects, are discussed. A.L

N71-22804# Israel Program fo Scientific Translations, Ltd., Jerusalem.
VARIATION OF THERMAL CHARACTERISTICS OF THE CHUKCHI SEA DURING PAST DECADES
A. O. Shpaikher et al *In its* Probl. of the Arctic and the Antarctic 1970 p 19–29 refs (See N71-22801 11-13)
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The long term variations of the water, thermal, and saline influxes of the Pacific water temperatures in the Chukchi Sea reveal two decades during which the hydrological process developed against the background of low and high water temperatures. To obtain a spatial concept of the differences in the thermal state of the Chukchi Sea at the regular grid nodes, average surface water temperatures were calculated for the last third of July, middle third of August, and middle third of September in the decades 1947–1956 and 1957–1966, followed by calculation of differences and compilation of charts. A salinity variation chart for September was obtained in a similar manner. The difference charts for water temperatures reveal that the warming for the last third of July during the last decade was most marked (2 C) in the region along the Chukchi coast. The phenomenon was apparently due to intensification of the DeLong branch of the Pacific Current and attenuation of the cold Chukchi Current. A.L

N71-22805# Israel Program for Scientific Translations, Ltd., Jerusalem.
SOME CHARACTERISTICS OF LARGE SCALE TURBULENCE OF CURRENTS IN THE ARCTIC BASIC AND ARCTIC SEAS
V. V. Panov *In its* Probl. of the Arctic and the Antarctic 1970 p 30–36 refs (See N71-22801 11-13)
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The variability of the characteristics of large scale turbulence in the Kara, Laptev, East Siberian, and Chukchi seas and Arctic Basin, calculated from measurements of currents by autonomous buoy stations, is presented in tabular form. A.L

N71-22806# Israel Program for Scientific Translations, Ltd., Jerusalem.
ON THE STUDY OF BIENNIAL VARIATIONS OF ATMOSPHERE CIRCULATION IN THE NORTHERN HEMISPHERE
B. A. Sleptsov-Shevlevich *In its* Probl. of the Arctic and the Antarctic 1970 p 37–45 refs (See N71-22801 11-13)
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This investigation was based on monthly data on the frequency of the western form of atmospheric circulation over the period 1891 through 1964. These atmospheric circulation indexes were subjected to harmonic analysis with a period of 12 months. The harmonic analysis of annual series yielded the amplitude and seasonal variation phases of the zonal atmospheric circulation. The seasonal variation amplitudes of circulation indexes and the values of calculated characteristics are presented. Results of the investigation attest, in varying degrees, to a solar origin of the biennial cycle. The inverse relation discovered does not contradict the established theory concerning the effect of solar activity on the terrestrial atmosphere. High solar activity is known to be closely related to anomalous disturbances of the terrestrial magnetic field, disturbances of zonal stability in atmospheric circulation, and with enhanced meridional circulation processes. A.L

N71-22807# Israel Program for Scientific Translations, Ltd., Jerusalem.
SEASONAL VARIATIONS OF THE ICE COVER AND THE POSSIBILITY OF FORECASTING THEM
A. A. Kirillov et al *In its* Probl. of the Arctic and the Antarctic 1970 p 46–55 (See N71-22801 11-13)
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The proposed method of long range forecasting of the seasonal variations of the ice cover and the ice cluster area is based on data supplied by observations in the southwestern part of the Kara Sea. The seasonal variation of ice cover in this part of the Kara Sea and the area of the Novaya Zemlya ice cluster possesses the following two characteristics; (1) gradual, but nonuniform decrease of ice cover from one decade of days to another, and (2) preservation of the signal anomaly of ice cover and ice cluster area throughout the summer. Application of the proposed method is limited to those regions where summer ice exchange is small and

does not display large variations within a season and from year to year. A characteristic feature of the proposed method is applicability to both long range forecasting and its corrections and short range forecasting of decade earliness. A.L.

N71-22808# Israel Program for Scientific Translations, Ltd., Jerusalem.

ROLE OF THERMAL REGIME OF THE WATER BODY IN FORMATION OF THE CRYSTAL STRUCTURE OF ICE

N. V. Cherepanov *In its* Probl. of the Arctic and the Antarctic 1970 p 56-64 refs (See N71-22801 11-13)

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The spatial orientation of crystals in ice formed in water bodies with different temperature regimes was investigated. Results indicate that: (1) The thermal regime of the water body during ice formation is one of the main factors determining the structural properties of ice cover. (2) Water bodies with stable temperature stratification form an ice cover with vertical optical axes of the crystals, and possessing great strength. (3) Water bodies in which a considerable thickness of water is uniformly cooled to a temperature close to freezing during ice formation form an ice cover with horizontal optical axes of crystals. (4) The orientation of the principal crystallographic axes of crystals is unrelated to the external shape of the ice cover of the water bodies. (5) Establishment of the relationship between the hydrological regime of a water body and the crystal structure of the ice cover makes it possible in the future to predict certain physical and mechanical characteristics of the ice cover by using hydrometeorological elements. A.L.

N71-22809# Israel Program for Scientific Translations, Ltd., Jerusalem.

METHODS FOR SHORT RANGE FORECASTING OF NAVIGABILITY IN CLOSE SEA ICE

V. I. Smirnov *In its* Probl. of the Arctic and the Antarctic 1970 p 65-70 refs (See N71-22801 11-13)

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A method has been devised for forecasting the navigability of close pack ice by icebreakers operating in the Arctic. The formula for calculating pure ice resistance was modified so that the parameters characterizing the icebreaker are one side, and the parameters related to ice are on the other side of the equation. Each type of icebreaker would have a navigability index constant for ice cake. The proposed method is applicable only for movement of ships without breaking the ice. This technique makes possible an improved approach to forecasting the starting and ending dates for convoying ships through the ice. A.L.

N71-22810# Israel Program for Scientific Translations, Ltd., Jerusalem.

SPECTRA OF MICROSEISMS AND FLEXURAL GRAVITY WAVES SPECTRA IN THE MIRNY REGION

V. N. Smirnov *In its* Probl. of the Arctic and the Antarctic 1970 p 71-80 refs (See N71-22801 11-13)

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Simultaneous observations of microseisms and the natural oscillation of the floating ice cover were carried out at Mirny in Antarctica. The spectra of the long period microseisms and flexural gravity waves are compared. Flexural gravity waves were studied using pendulum tiltmeters with magnetron converters. The instruments were installed directly on ice on pedestals frozen into pits and covered with wooden cases. The instruments were arranged in a triangle of 100 m and 200 m sides with mutually perpendicular tiltmeters in the apex. The oscillations were recorded telemetrically with the sensors located at a distance of 500 m from shore. The Mirny seismic station was located on bedrock on shore. As a result of these investigations, it is fairly well established that microseisms represent the superposition of two types of surface waves, Rayleigh and Love waves. Each of these microseismic components is characterized by a definite propagation velocity and polarization. A.L.

N71-22811# Israel Program for Scientific Translations, Ltd., Jerusalem.

HEAT BALANCE CONDITIONS OF FORMATION AND ABLATION OF WEST SPITSBERGEN GLACIERS IN 1965

V. A. Markin *In its* Probl. of the Arctic and the Antarctic 1970 p 81-89 refs (See N71-22801 11-13)

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In the summer of 1965, observations were carried out on the West Spitsbergen glaciers by the first Soviet glaciological expedition. One of the major items in the program of scientific investigations were stationary glacio-climatological observations on the summit surface of the Lomonosov glacier plateau. These were the first investigations of their kind carried out at absolute elevation over 1000 m within the boundaries of the cold firn zone. The glacio-climatological observations on the Lomonosov glacier plateau were conducted from 23 June through 19 August. They included observations of the duration of sunshine by a heliograph, incoming total diffuse and direct radiation, radiation balance and snow surface albedo, air temperature and humidity in the meteorological screen, velocity of the wind and its direction, surface temperature, gradient of air temperature and humidity in the surface layer. Author

N71-22812# Israel Program for Scientific Translations, Ltd., Jerusalem.

PERSPECTIVES OF THE ELECTROMAGNETIC METHOD FOR WATER CURRENT VELOCITY MEASUREMENTS IN ARCTIC REGIONS

G. A. Fonarev et al *In its* Probl. of the Arctic and the Antarctic 1970 p 90-98 refs (See N71-22801 11-13)

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The physical principles of the EM method of velocity measurement are discussed along with some of the interferences and the prospects of using the method in arctic waters, which possess the following special features from the standpoint of using the EM method: (1) The vertical components of the earth's magnetic field are at their maximum. (2) In the Arctic there are frequent magnetic disturbances of high intensities, and the electric currents induced in the water by these disturbances constitute the principal interference for EM recording of velocities. (3) Large regions in the Arctic contain fast and pack ice. Three varieties of the EM method can be used in oceanography: 1) measurements from an immobile platform (from shore, from a buoy, from fast ice, at the bottom); 2) measurements from a mobile platform (from shipboard, from pack ice); 3) methods making use of artificial magnetic fields. Author

N71-22813# Israel Program for Scientific Translations, Ltd., Jerusalem.

DISTRIBUTION OF MAGNETIC ACTIVITY IN THE ARCTIC IN THE IGY

N. N. Zhigalova *In its* Probl. of the Arctic and the Antarctic 1970 p 99-104 refs (See N71-22801 11-13)

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Analyses were made of the synoptic charts of the magnetic activity measured in 1958 at 25 polar stations. These charts were based on the r(gamma)sub H index rather than the Q index. The hourly synoptic charts were constructed in geomagnetic coordinates separately for every month in 1958, for five international disturbed days. The isolines on the charts were drawn at intervals of 100 gamma. Diurnal distributions of the number of focal centers for winter, summer, and equinox are discussed and presented graphically. Mean charts of magnetic activity constructed in corrected geomagnetic coordinates are presented. These charts display an oval zone situated around the geomagnetic pole, where the intensity is

higher than in the surrounding regions. The oval distribution of magnetic activity confirms Burdo's conclusion concerning the spiral distribution of the time of appearance of maxima and Nikolskii's conclusions concerning the spiral distribution of morning magnetic disturbances. A.L.

N71-22817# Israel Program for Scientific Translations, Ltd., Jerusalem.

ON THE PROBLEM OF THE ATMOSPHERIC CIRCULATION EFFECT ON THE DISTRIBUTION OF TOTAL RADIATION IN THE ARCTIC

N. A. Volkov et al *In its* Probl. of the Arctic and the Antarctic 1970 p 122–128 refs (See N71-22801 11-13)

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The authors offer several comments on the methodic principles and conclusions reached by A. A. Girs in his research on the role of atmospheric circulation in formation of the thermal regime of the Arctic. The strongest objection raised was Girs' attempt at detecting the differences in total radiation influx in the Arctic for different forms of macrosynoptic processes established by Vangengeim for the Atlantic-Eurasian sector of the Northern Hemisphere. A.L.

N71-22818# Israel Program for Scientific Translations, Ltd., Jerusalem.

REPLY TO THE REVIEW OF N. A. VOLKOV, Z. M. GUDKOVICH AND A. V. SMETANNIKOVA

A. A. Girs *In its* Probl. of the Arctic and the Antarctic 1970 p 129–138 (See N71-22801 11-13)

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A. A. Girs presents his rebuttal to the review by Volkov, Gudkovich, and Smetannikova (see N71-22817) of his research on the role of atmospheric circulation in formation of the thermal regime of the Arctic. He discusses in detail each of the three main points in their paper and concludes that they failed to disprove the major concepts in his research. A.L.

N71-22820# Israel Program for Scientific Translations, Jerusalem.

ROLE OF THE ARCTIC BASIN IN THE STRUCTURAL DEVELOPMENT OF LAURASIA

P. S. Voronov *In its* Probl. of the Arctic and the Antarctic 1970 p 148–157 refs (See N71-22801 11-13)

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The mobilist approach to the reconstruction of Laurasia is presented. This approach depends upon delineating correctly the stages in the mobilist development of the depression occupied by the Arctic Basin, with its extensive areas of oceanic crust. One of the main principles of the mobilist reconstructions, satisfactory geomorphological and geostructural fitting together of the present day continental crust blocks, makes it possible to close the depressions of the Arctic Basin and the North Atlantic completely, by fitting together the Canadian, Siberian, Norwegian, Greenland, and other stretches of the continental slopes of North America, Asia, and Europe. It is pointed out that the horizontal movements that produced the common depression of the Arctic Basin were of a dual nature. In the first stage it is most likely that they were engendered by the forces directed away from the pole, probably in conjunction with forces generated by convection of the mantle substance, while in the second stage they were due to some causes of a more general nature, possibly even cosmogonic. A.L.

N71-22821# Israel Program for Scientific Translations, Ltd., Jerusalem.

INDEXES OF THE POSSIBLE EFFECT OF MULTIANNUAL VARIATIONS IN TIDAL TYPE FORCES ON THE OCEAN AND THE ATMOSPHERE

I. V. Maksimov et al *In its* Probl. of the Arctic and the Antarctic 1970 p 158–164 refs (See N71-22801 11-13)

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Tidal type forces are defined as the tide generating forces of the moon and sun and the deformation force generated by the free and forced movements of the earth's poles. The combined effect of these forces on atmospheric processes is a controversial subject. The application of theoretical simulation to investigation of this effect is extremely difficult, so that empirical studies of the interrelationship between these forces and the actual processes on earth are the most practical approach. The total potential of the long period component of the tide generating force of the moon and the sun as well as the potential of the deformation force generated by the movements of the earth's poles were regarded as the principal components forming the variable part of the gravity field. The force potential being a scalar quality, it was necessary to calculate the quantitative expression for the force vectors directed along different geographic axes. Complete derivations are given for the equations for the horizontal and vertical components of the long period component of the tide generating force and the deformation force. A.L.

N71-22822# Israel Program for Scientific Translations, Ltd., Jerusalem.

HORIZONTAL CIRCULATION OF WATER IN THE PACIFIC SECTOR OF THE SOUTHERN OCEAN

Yu. A. Grigorev *In its* Probl. of the Arctic and the Antarctic 1970 p 165–174 refs (See N71-22801 11-13)

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Analysis of the circulation of water was carried out using hydrologic observations collected during the summer period. The observation data was not fully suitable in the original form and had to be systematized by averaging or reduction, to a common denominator. Practical experience of investigations in the Southern Ocean had shown that the results of hydrologic observations can be most conveniently analyzed by sections. The entire area was divided in six-degree meridional zones with each zone having a central meridian. Only data from stations in which the temperature and salinity were in accordance with overall variation of the parameters along the central meridian were included in the calculations. Dynamic calculations were made and dynamic topographic charts constructed for the 0, 500, 1,000, 3,000, and 4,000 meter levels. A.L.

N71-22823# Israel Program for Scientific Translations, Ltd., Jerusalem.

PREDICTING THE SIGN OF THE FREQUENCY ANOMALY OF CIRCULATION FORMS

M. Sh. Bolotinskaya *In its* Probl. of the Arctic and the Antarctic 1970 p 175–185 refs (See N71-22801 11-13)

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Current scientific meteorological forecasts of specific operations and measures in connection with navigation also call for a more differentiated forecast with respect to time, which should be at least three months ahead of the operations in hand. Therefore, simultaneously with the method of basic long range forecasting, work has been done on a method for improving its accuracy and detail for the coming three months. The method was based on the known features of the continuous development of atmospheric circulation in groups of homogeneous and homologous processes. Detailed forecasts for the navigation season, including the summer months, are the most important ones for practical purposes. The established groups of homogeneous processes for better accuracy and detail of the basic long range forecasting for June–August satisfactorily reflect the main schemes of the transformation of circulation forms. Author

N71-22824# Israel Program for Scientific Translations, Ltd., Jerusalem.

THE TEMPERATURE HUMIDITY REGIME OF THE ARCTIC

IN THE SUMMER PERIOD

I. N. Zavyalova *In its* Probl. of the Arctic and the Antarctic 1970 p 186–195 refs (See N71-22801 11-13)

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These investigations were based on data reported by five polar stations, separately for both day and night, for the months of June, July, and August from 1962–1965. The data were used to compute the frequency of the combinations of temperature-relative humidity and temperature-absolute humidity at temperature intervals of 2 deg, relative humidity intervals of 5%, and absolute humidity intervals of 1 mb. The analysis proved that the use of standard observation data yields adequately accurate characteristics of the temperature-humidity regime during the summer period in the Arctic. A.L.

N71-22825# Israel Program for Scientific Translations, Ltd., Jerusalem.

PREDICTING LOCATION OF BARIC FORMATION CENTERS AND THEIR EVOLUTION ON THE THIRD DAY

M. P. Evseev *In its* Probl. of the Arctic and the Antarctic 1970 p 196–205 refs (See N71-22801 11-13)

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A technique is outlined for predicting the location of the baric formation centers and their evolution in the Arctic and Subarctic on the third day based on the relationships between the variations of the thermal field of the troposphere and pressure variations at the earth's surface. Author

N71-22826# Israel Program for Scientific Translations, Ltd., Jerusalem.

EFFECT OF THE THERMAL STATE OF POLAR REGIONS ON VORTICAL ACTIVITY IN THE ATMOSPHERE

K. I. Chukanin *In its* Probl. of the Arctic and the Antarctic 1970 p 206–212 refs (See N71-22801 11-13)

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Information is provided on the frequencies of cyclonic vortices, the mean air densities, and the horizontal air temperature gradients over the nothern hemisphere for the period 1960–1964. A comparison of these data makes it possible to determine certain features of the annual march of the number of cyclones over the northern hemisphere. The effect of the thermal state of the polar regions of the planet on the vorticity in the atmosphere is also illustrated. Author

N71-22827# Israel Program for Scientific Translations, Ltd., Jerusalem.

DETERMINATION OF THE VERTICAL TEMPERATURE PROFILE IN THE ARCTIC ATMOSPHERE FROM OUTGOING MICROWAVE RADIATION

T. I. Bazlova *In its* Probl. of the Arctic and the Antarctic 1970 p 213–229 refs (See N71-22801 11-13)

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Investigations of the method for temperature probing of the atmosphere from outgoing radiation in the 5 mm O2 band, with attention paid mainly to the selection of the spectrum region in which the predominant contribution to the absorption of radiation is made by molecular oxygen, are discussed. This spectrum region was studied for sections where the measurements would make it possible to calculate the vertical temperature profile. Calculations showed that the method is promising for determining the temperature profile from outgoing radiation. A.L.

N71-22828# Israel Program for Scientific Translations, Ltd., Jerusalem.

THE RELATIONSHIP BETWEEN POLAR MAGNETIC DISTURBANCES AND THE RATE OF RING CURRENT VARIATION

G. I. Ul *In its* Probl. of the Arctic and the Antarctic 1970 p 230–238 refs (See N71-22801 11-13)

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The relationship between two disturbed field components of a geomagnetic disturbance field were investigated. This research was based on the hourly amplitude of horizontal intensity measured at seven polar stations during the period July 1957–December 1958. The method of superposition of epochs, choosing the moments of the main phase maximum of magnetic storms as the zero hour, was used. These investigations do not permit positive statements to be made that rapid increases in the ring current are the cause of polar disturbances. Most probably, these phenomena develop in parallel and are created by a single common cause, possibly by the acceleration of charged particles in the magnetospheric train. Some of these particles are conveyed by the lines of force directly to the auroral zone, producing polar disturbances, while others move along the neutral layer and enter the ring current, producing growths. A.L.

N71-22829# Israel Program for Scientific Translations, Ltd., Jerusalem.

BEDFORD PYM'S PROJECT

V. M. Pasetskii *In its* Probl. of the Arctic and the Antarctic 1970 p 239–250 refs (See N71-22801 11-13)

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A historical review is presented of the polar exploration plan submitted in 1851 by Lieutenant Bedford Pym of the British Royal Navy to search Russian territory for the missing John Franklin expedition. The outline of expedition plan and the reasons for Soviet refusal to permit the expedition are presented. A.L.

N71-22832# Israel Program for Scientific Translations, Ltd., Jerusalem.

FOURTH ALL-UNION GLACIOLOGICAL SYMPOSIUM

V. G. Averyanov *In its* Probl. of the Arctic and the Antarctic 1970 p 259–262 Symp. held at Mt. Elborus, Kabardino-Balkarian ASSR, 21 Sep.–5 Oct. 1968 (See N71-22801 11-13)

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The All-Union symposium was held between 21 September and 5 October 1968 near Mt. Elborus in the Kabardino-Balkarian ASSR. The symposium was devoted to glaciation of highlands and some 120 papers were presented dealing with modern glaciology, glaciers, snow cover, sea ice, avalanches, and icings. The papers reflected the results of comprehensive glacio-hydroclimatological studies of mountain glaciers, various aspects of paleoglaciology, engineering glaciology, and investigation methods. A.L.

N71-22833# Israel Program for Scientific Translations, Ltd., Jerusalem.

NEW GEOGRAPHICAL NAMES ON THE MAP OF FRANZ JOSEF LAND

Ya. Ya. Gakkel et al *In its* Probl. of the Arctic and the Antarctic 1970 p 263–265 refs (See N71-22801 11-13)

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In order to rectify and eliminate duplications and misunderstandings of arbitrarily named geographical points and locations, and to give names to previously unnamed locations, an official list was compiled in 1963 of 157 prominent and large elements of coastline, relief, and ice cover on Franz Josef Land. The new names included scientists, astronauts, ice breakers, space flights, cities, etc. Wherein possible, those names that enjoyed extensive everyday use in scientific investigations and appeared in published papers were retained. A.L.

N71-22834# Israel Program for Scientific Translations, Ltd., Jerusalem.

ILLUSTRATED GLOSSARY OF SNOW AND ICE

A. O. Shpaikher *In its* Probl. of the Arctic and the Antarctic 1970 p 266–268 refs (See N71-22801 11-13)
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The revised edition of the Illustrated Glossary makes extensive use of previously published ice albums, glossaries, manuals, and investigations by scientists of the United Kingdom, U.S.S.R., United States, Germany, Denmark, Iceland, Norway, Finland, France, and Sweden. The section of the glossary dealing with definitions and linguistic equivalents is arranged alphabetically and furnishes not only the terminology but definitions and brief explanations. In addition to the English terminology, it supplies the Danish, Finnish, French, German, Icelandic, Norwegian, Russian, and Spanish equivalents, which make the dictionary especially valuable and an indispensible reference in studying scientific works published in different countries. A.L.

N71-22835# Israel Program for Scientific Translations, Ltd., Jerusalem.
FORMATION OF ANOMALIES OF WINTER HYDROLOGICAL CHARACTERISTICS OF THE EAST SIBERIAN AND CHUKCHI SEAS
A. O. Shpaikher et al *In its* Probl. of the Arctic and the Antarctic 1970 p 273–281 refs (See N71-22801 11-13)
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Analysis of the distribution of the hydrological elements revealed close interrelationships between the baric relief, temperature, and salinity of arctic surface waters and Pacific surface waters in the East Siberian and Chukchi seas. The influence of Pacific waters on the hydrological regime of the Chukchi and East Siberian seas is more marked in winter when the salinity fluctuations, due to variable discharge through the Bering Strait, are not masked by the addition of fresh water from melting ice and continental runoff. The temperature of the surface layer in winter is close to freezing point, which is thus determined by the salinity. Graphs of annual variations of the winter hydrological characteristics in the surface waters of these two seas exhibit alternating periods of high and low salinity and correspondingly higher or lower water temperatures. A.L.

N71-22836# Israel Program for Scientific Translations, Ltd., Jerusalem.
DEFORMATION FORCES AND SHORT RANGE WEATHER FORECASTS
I. V. Maksimov *In its* Probl. of the Arctic and the Antarctic 1970 p 282–293 refs (See N71-22801 11-13)
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The significance of deformation forces concerning short range forecasting of the earth's baric field and subsequently for short range weather forecasts is discussed. The deformational anomalies of the mean ocean level in the Northern Hemisphere were calculated and these anomalies constitute the constant component of the complex variable deformation background of the ocean level surface. Parameters of the deformational background of the ocean level surface can be converted to approximate values of the mean atmospheric pressure anomalies by means of an empirical equation. The deformation of level due to solar activity variations was also calculated from the solar activity forecast using empirical equations. The method also requires that effects of tidal forces be taken into consideration. Forecasts of the development of a baric situation created by deformation forces must probably be made by means of the conventional forecasting methods. Consequently, the method discussed does not substitute but supplements the existing method of weather forecasting. A.L.

N71-22837# Israel Program for Scientific Translations, Ltd., Jerusalem.
SEA ICE OF THE SOUTHERN OCEAN
L. I. Eskin *In its* Probl. of the Arctic and the Antarctic 1970 p 294–301 refs (See N71-22801 11-13)
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The effects of sea ice and icebergs of the Southern Ocean on the thermophysical processes of the earth are discussed. The temperate latitudes in the southern hemisphere are colder than the corresponding latitudes in the northern hemisphere. One of the reasons is the melting of huge quantities of ice during the warm period from October to March. The melting of the ice is affected by the salinity and the concentration of plankton inclusions. Conversely, steady ice formation starts approximately in mid-March, and by mid-April fast ice starts to form in bays, inlets, and along eastern shores. The establishment of fast ice is followed by rapid growth both on the surface and on the underside. Pack ice reaches its highest development in September and the beginning of October. Observations of all the coastal Antarctic stations have established the existence of a stationary polynya which probably encircles it entirely. The effects of this polynya on the hydrometeorological remine of the adjacent regions is discussed. A.L.

N71-22838# Israel Program for Scientific Translations, Ltd., Jerusalem.
ON THE RELATIONS BETWEEN THE FREQUENCY OF MERIDIONAL FORMS OF ATMOSPHERIC CIRCULATION AND SOLAR CORPUSCULAR EMISSION
M. Sh. Bolotinskaya et al *In its* Probl. of the Arctic and the Antarctic 1970 p 302–307 refs (See N71-22801 11-13)
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Changes of atmospheric circulation due to influence of solar activity were investigated. It was concluded that solar corpuscular emission has a definite influence on occurrence frequency of processes of the meridional circulation forms. A.L.

N71-22839# Israel Program for Scientific Translations, Ltd., Jerusalem.
GEOMAGNETIC ACTIVITY AT SOVIET ARCTIC STATIONS IN THE LAST THREE SOLAR ACTIVITY CYCLES
L. N. Zhigalov et al *In its* Probl. of the Arctic and the Antarctic 1970 p 308–319 (See N71-22801 11-13)
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The diurnal variation in magnetic activity during different years of the solar activity cycle was examined and the behavior of magnetic activity during the different phases of the solar cycle was determined. The diurnal variation in magnetic activity was considered for both years with the minimum and maximum Wolf numbers (W), as well as anomalous years during which W values were much smaller than at the cycle's maximum and yet magnetic activity was fairly high. Examinations were also made of the seasonal variations in magnetic activity. A.L.

N71-22840# Israel Program for Scientific Translations, Ltd., Jerusalem.
VERTICAL ELECTRIC FIELDS OF SEA CURRENTS
G. A. Fonarev et al *In its* Probl. of the Arctic and the Antarctic 1970 p 320–325 refs (See N71-22801 11-13)
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Increased attention has been directed toward observations of vertical electric fields in the ocean and their relation to a possible new approach to the study of the physicochemical processes operating within the water column. Also of interest is the possibility of using the vertical electric field of currents for measurements of the velocity of the currents. Results of experiments conducted in the tidal flow of Yermak Strait in the region of Franz Josef Land, using silver chloride electrode half-cells and mirror galvanometers, indicate that recording of the vertical component of the electrical field of sea currents yields valuable information and is recommended for observations of tidal currents in the polar regions with fast ice. A.L.

N71-22841# Israel Program for Scientific Translations, Ltd., Jerusalem.

MAJOR GEOMORPHOLOGICAL FEATURES OF THE BOTTOM OF THE BERING SEA AND GULF OF ALASKA

E. E. Gershanovich *In its* Probl. of the Arctic and the Antarctic 1970 p 326-333 refs (See N71-22801 11-13)

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The major geomorphological features of the extreme northern region of the Pacific adjacent to the Arctic Ocean, the Bering Sea and the Gulf of Alaska, are of interest in relation to data on topography of the Arctic Ocean obtained in recent years. Oceanographic observations have altered previously held opinions of bottom structure in these areas, and reveal a much greater complexity in relief than was formerly believed. Maps are presented showing the major geomorphological zones and the morphostructural scheme for the bottom of the Bering Sea and Gulf of Alaska. A.L.

N71-22842# Israel Program for Scientific Translations, Ltd., Jerusalem.

ECONOMIC EFFICIENCY CALCULATIONS FOR LONG RANGE ICE FORECASTS

A. I. Murzin et al *In its* Probl. of the Arctic and the Antarctic 1970 p 334-341 ref (See N71-22801 11-13)

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Calculation of the economic efficiency of an ice forecast requires: (1) direction of hauls; (2) volume of hauls over the crusing period in specific directions; (3) length of the various stage en route; (4) characteristic ice conditions on the various steges en route and on the entire route; (5) the time duration of each cruise with and without assistance of icebreakers; (6) overall speeds or icebreakers under various ice conditions, sailing by themselves of assisting typical convoys of freighters; and (7) norms for the processing of ships in the principal arctic ports. The calculations presented were based on the actual volume of shipments in the year 1965 for the western, central, and eastern regions of the Arctic. The distribution of the total shipments in differing directions was also based on actual freight movements in that year. A.L.

N71-22843# Israel Program for Scientific Translations, Ltd., Jerusalem.

CALCULATIONS OF ICE RESISTANCE TO THE MOVEMENT OF AN ICEBREAKER UNDER DIFFERING ICE CONDITIONS

A. Ya. Buzuev et al *In its* Probl. of the Arctic and the Antarctic 1970 p 342-346 (See N71-22801 11-13)

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Calculation methods based on theoretical analyses, simulation, and field experiments make possible the derivation of equations for the determination of the resistance encountered by a ship in consolidated and cake ice. These are not the only ice cover types encountered by ship sailing in freezing areas, and since the calculation methods for the resistance of small, medium, and large floes have considerable practical application, this investigation broadens these calculations and attempts to demarcate the application limits of the calculation methods so as to specify clearly the specific ice conditions for which they are applicable. The proposed method is based on data furnished by field tests using a powerful icebreaker, which involved some 500 measurements of the power plant output, the icebreaker speed, and ice characteristics in different ice fields. The quality of the results were tested by comparing the rated and measured rpm of the propeller and power plant output. Most of the measurements were made in ice having a concentration if 8/10 - 10/10. A.L.

N71-22844# Israel Program for Scientific Translations, Ltd., Jerusalem.

SEDIMENTATION IN THE LAPTEV SEA

P. N. Erofeev et al *In its* Probl. of the Arctic and the Antarctic 1970 p 347-350 refs (See N71-22801 11-13)

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Investigation of the vertical distribution of suspended matter in sea water provides a method of studying the mechanism of the transport and deposition of sedimentary material arriving in the sedimentation basin with water masses of varying origin. Samples of suspended matter in the Laptev Sea were collected from several hydrogeological profiles which were mostly situated near the delta of the Lena River. Water samples comprised 1 - 3 liters in volume and were taken from the sea surface and from several depths including the bottom. These investigations yielded a new concept of sedimentation mechanism in the Laptev Sea. For example, under steady state conditions of the movement of water masses, the suspended matter in the active layer is transported and deposited in the central and northern regions of the sea, and the suspended matter resulting from leaching of sediment by the compensating and tidal currents enter the regions near the deltas and shores where they are deposited, forming a high clay concentration sediment. This process occurs on a large scale, as it evidenced by the occurence of muds and clayey muds along the coast near the Lena Delta. A.L.

N71-22846# Israel Program for Scientific Translations, Ltd., Jerusalem.

SPECTRAL ALBEDO OF SNOW-ICE COVER

N. N. Bryazgin et al *In its* Probl. of the Arctic and the Antarctic 1970 p 355-360 refs (See N71-22801 11-13)

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Spectral albedo observations were conducted in the spring-summer period in order to observe the variations of snow and ice reflectivity under varying conditions of cloudiness and solar elevations, and to relate them to the physical state of the surface at low subzero temperatures and during the melt. The observation results showed that the values of longwave albedo in bright sunshine are higher than those in overcast weather at solar elevations extending to 17 deg, at which stage the ratio of these quantities is reversed as the solar elevations increase. The maximum difference between the integral and longwave albedos occurs in wet snow, amounting to 35%. The mean diurnal albedo values of snow, ice, and pools are presented in tabular form. A.L.

N71-22847# Israel Program for Scientific Translations, Ltd., Jerusalem.

THE DAY TO NIGHT RATIO OF ABSORPTION DURING PCA, 2 - 6 SEPTEMBER 1966

V. M. Driatskii *In its* Probl. of the Arctic and the Antarctic 1970 p 361-364 refs (See N71-22801 11-13)

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Day-to-night cosmic noise absorption values were estimated from recordings made at the Severnyi polyus-13 drift station and the Antarctic station Vostok for the polar cap absorption period 2-6 September 1966. The recordings of the riometers at both stations were identically processed for the first minute of every hour. The results of the measurements from both stations are displayed graphically. A.L.

N71-22849# Israel Program for Scientific Translations, Ltd., Jerusalem.

VARIABILITY IN THE DIRECTION OF S SUB D CURRENTS IN THE REGION OF GEOMAGNETIC POLES

B. G. Belousov et al *In its* Probl. of the Arctic and the Antarctic 1970 p 368-371 refs (See N71-22801 11-13)

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The variation in the direction of the S sub D currents in relation to the magnetic activity index based on data from the Thule and Resolute Bay stations for the winter IGY season was

examined, as well as variation and direction of S sub D currents in the solar activity cycle from data reported by Vostok station for winters of IGY and IQSY. Results of these investigations, together with other morphological peculiarities in the distribution of magnetic disturbances in the high latitudes, can probably be used for correcting and checking physical hypotheses concerning the nature of the disturbances themselves, to the extent that the relationship between the variations in the direction of the S sub D currents in the polar cap during the solar activity cycle and the solar wind velocity as well as the intensity of the neutron component of cosmic rays, may be regarded as established. A.L

N71-22851# Israel Program for Scientific Translations, Ltd., Jerusalem.

SOME BASIC PROBLEMS IN RECENT OCEANOGRAPHY

I. V. Maksimov et al *In its* Problm of the Arctic and the Antarctic 1970 p 381-394 refs (See N71-22801 11-13)

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Development of techniques aimed at solving the fundamental question of the character, generalities and causes of the changes in the state of the ocean, and the dynamics of the main circulation in ocean systems is considered of prime importance in modern oceanographic research. Some important large scale ocean problems investigated were: (1) long period tidal phenomena; (2) changes of oceanic circulation and effects on hydrological levels in oceans; (3) interaction of ocean with atmospheric circulation; (4) long period oscillations resulting from free and forced motions of the earth's poles; (5) nutational phenomena in earth atmosphere; and (6) solar activity effects. A.L

N71-22852# Israel Program for Scientific Translations, Ltd., Jerusalem.

ZERO SURFACE AND WATER CIRCULATION IN DRAKE PASSAGE DURING SUMMER

V. N. Botnikov *In its* Probl. of the Arctic and the Antarctic 1970 p 395-406 (See N71-22801 11-13)

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A brief review of ideas related to water circulation in the Drake Passage showed that currents were calculated from reference surfaces of 1,000, 2,500, 3,000, and 3,500 db. To solve a number of scientific and practical problems, the true surface water circulation must be known. Included are problems of water, heat, and salt exchange. These problems are important since the Drake Passage joins the Atlantic and Pacific Oceans. A method of solving the absolute value of water transport through the Drake Passage in the eastern and western directions, based on a zero surface depth, is discussed. A.L

N71-22853# Israel Program for Scientific Translations, Ltd., Jerusalem.

MEAN THICKNESS OF FAST ICE AS A FUNCTION OF HUMMOCKING

A. Ya. Buzuev et al *In its* Probl. of the Arctic and the Antarctic 1970 p 407-413 refs (See N71-22801 11-13)

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In estimating the effect of hummocking on mean ice thickness, the same water displacement as that proposed by Loshchilov was assumed, along with an identical solidity factor for both parts of the hummock. In determining the role of hummocking a preliminary evaluation was made of the dates of fast ice formation, the ice thickness at the end of the winter, and the mean height of hummocks. Data obtained from continuous recording of ice thicknesses from onboard an icebreaker were used in the solution. It is pointed out that quantitative relationships obtained are valid only for specific conditions. Changes in the height of hummocks, ice thicknesses at the end of the winter, and dates of establishment of fast ice will change the relative importance of the hummocking. However, the calculation technique described can be applied to each specific case. A.L

N71-22854# Israel Program for Scientific Translations, Ltd., Jerusalem.

METHODS OF COMPUTATIVE FORECASTING ON NONPERIODIC OSCILLATIONS IN THE SEA LEVEL

N. V. Mustafin *In its* Probl. of the Arctic and the Antarctic 1970 p 414-421 ref (See N71-22801 11-13)

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Cape Schmidt was used for forecasting nonperiodic sea level oscillations by computative means. The bases of the investigation were space-time graphs of such oscillations studied simultaneously with synoptic maps. The graphs were placed one below the other in accordance with the location of the stations from west to east. The level was plotted on the vertical scale (in centimeters) and the time on the horizontal scale (in hours and days). This graphical construction facilitated study of the spatial propagation of high-low level oscillations in the East Siberian and Chukchi seas, as well as the temporal oscillations recorded during each navigational month. Thus, a clear idea of successive oscillations was obtained for the complete navigational period. As a result of this analysis, a reasonable correlation was established between oscillations in the East Siberian and Chukchi seas. To render a quantitative standard to this, the correlation coefficients between the oscillations of the mean navigation levels of the most representative stations were calculated. Author

N71-22855# Israel Program for Scientific Translations, Ltd., Jerusalem.

A TECHNIQUE OF FORECASTING DATES WHEN THE ICE REACHES A THICKNESS OF 20-25 cm

E. M. Gushchenkov *In its* Probl. of the Arctic and the Antarctic 1970 p 422-428 refs (See N71-22801 11-13)

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An attempt was made to analyze the conditions of ice growth up to the gray-white color state, and to assess the dates when the ice achieves this thickness within a forewarning period of up to 20 days in the case of the eastern Arctic seas. The initial material for the work were freezing and ice growth data from observations carried out at polar stations. The complete eastern route from the Laptev Sea to the Bering Strait was arbitrarily divided into four sections, each distinguished by the conditions of freezing and ice growth. It was assumed that the mean data was representative of the conditions of freezing and ice growth in each of the indicated regions. Author

N71-22856# Israel Program for Scientific Translations, Ltd., Jerusalem.

CLASSIFICATION OF PRESSURE FIELDS BY EXPANSION IN NATURAL ORTHOGONAL FUNCTIONS

G. I. Bardin *In its* Probl. of the Arctic and the Antarctic 1970 p 429-439 refs (See N71-22801 11-13)

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One method for an objective classification of synoptic processes is presented. This was worked out for the region of northern Yakutia during the winter by means of the expansion of the pressure fields in natural orthogonal functions. In the classification process, use is made of the optimum cycle algorithm. By using the results of an objective classification, it is possible to obtain well-defined weather characteristics for a given specific region. These, in turn, will confirm the expediency of the classification itself and subsequently can be used in short term weather forecasts. Author

N71-22857# Israel Program for Scientific Translations, Ltd. Jerusalem.

SOME WIND CHARACTERISTICS IN THE ARCTIC

L. E. Anapolskaya et al *In its* Probl. of the Arctic and the Antarctic 1970 p 440-447 refs (See N71-22801 11-13)

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A detailed examination of the peculiarities of Arctic stations and evaluation of the exposure of their location indicated that the

accepted classification had to be refined for the Arctic conditions. A refinement was made which made it possible to allow for the influence of open water surfaces from the north and the complex topography in the southern part of the horizon. The location of all meteorological stations in the Arctic was estimated with respect to eight points of the compass, according to the new classification. Of high practical interest were data on the recurrence of wind velocities, once per year, 5 years, 10 years, 15 years, 20 years, and on the direction of winds of considerable velocities. Data are presented in tabular form on wind velocities and probability of occurrence for selected stations and regions of the Soviet Arctic. A.L.

N71-22859# Israel Program for Scientific Translations, Ltd., Jerusalem.

EVALUATION OF REGULAR ABSORPTION IN HIGH LATITUDES FROM RADIOMETRIC OBSERVATION DATA

V. M. Lukashkin *In its* Probl. of the Arctic and the Antarctic 1970 p 456–462 refs (See N71-22801 11-13)

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Analysis of radiometric observations made in the Soviet Arctic indicate: (1) Existing equipment is sufficiently accurate for distinguishing regular absorption in high latitudes. (2) Regular absorption is at a maximum in June and minimum in October to February. Noon absorption in June is about 0.4 db; in March and September, approximately 0.2 db; and in December, about 0.12 db. (3) The dirurnal variation of regular absorption in summer and at the equinox displays a clear solar control. The average value of the power for these months is 0.58. (4) In winter months the relationship with the zenith solar angles is weakened. (5) It may be assumed that in years of minimum solar activity, the main contribution to regular absorption is made by the zone D A.L.

N71-22861# Israel Program for Scientific Translations, Ltd., Jerusalem.

DETERMINATION OF MAXIMUM STAY OF INDUSTRIAL VESSELS IN REGIONS OF ICING

E. N. Kultashew et al *In its* Probl. of the Arctic and the Antarctic 1970 p 473–478 refs (See N71-22801 11-13)

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A series of graphs have been developed to assist a ship's captain in determining the stay time of a commercial vessel in icing conditions after the accumulation of a dangerous ice load. These graphs are based on various icing intensities and ship sizes, and are to be used in conjunction with up-to-date weather forecasts. A.L.

N71-22862# Israel Program for Scientific Translations, Ltd., Jerusalem.

TRANSFORMATION OF FORM AND DISPLACEMENT OF AIR INCLUSIONS IN ICE

D. E. Kheisin et al *In its* Probl. of the Arctic and the Antarctic 1970 p 479–485 refs (See N71-22801 11-13)

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A physical description is presented of the transformation processes of the form of air inclusions in ice due to molecular rearrangement in the ice crystals as determined by the thermodynamic laws of equilibrium. Also considered is the displacement of air inclusions in ice due to a temperature gradient. Author

N71-22863# Israel Program for Scientific Translations, Ltd., Jerusalem.

VARIABILITY OF THE TEMPERATURE AND HYDROCHEMICAL CHARACTERISTICS OF LAKE VANDA

A. O. Shpaikher *In its* Probl. of the Arctic and the Antarctic 1970 p 486–495 refs (See N71-22801 11-13)

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Analysis of deep water hydrological tests made on Lake Vanda from 1960 through 1965 indicate: (1) Year-to-year water temperature variations from the surface to the upper boundary of the isothermal layer do not agree with the temperature variations of the bottom layer. Also, comparisons of the time variations of temperature gradients of surface and bottom layers with depth variations of the upper and lower surfaces of the isothermal layer indicate that a decrease in the vertical gradients of the surface layer corresponds to a rise of the lower boundary of the isothermal layer and vice versa. (2) In contrast to the temperature distribution, the increase in mineralization of the lake water does not always follow an increase in depth. Observation data were not sufficient to trace seasonal variations in the concentration of chemical elements. A.L.

N71-22865# Israel Program for Scientific Translations, Ltd., Jerusalem.

ON THE OVAL DISTRIBUTION OF THE MAGNETIC DISTURBANCE IN THE ARCTIC DURING THE IQSY

L. I. Zhigalov et al *In its* Probl. of the Arctic and the Antarctic 1970 p 501–505 refs (See N71-22801 11-13)

Copyright. Avail: NTIS HC$6.00/MF$0.95

A comparison was made between the space-time distribution of the magnetic activity during the IGY and IQSY. Maps for the summer and winter of all days in 1964 and 1965 are presented. Examination of these maps shows that in the period of low solar activity, the space-time distribution of the magnetic disturbance is preserved, the form of the oval remaining almost the same as in years of high solar activity. However, the intensity of the disturbance in the oval and the size of oval itself decrease. The strongest decrease of disturbance occurs at daytime and morning hours. During the night, the disturbance decreases by a factor 1.3 - 1.4, that is, in passing from the maximum years to minimum years of solar activity, a redistribution of the intensity of magnetic disturbance in the activity foci takes place. A.L.

N71-22867# Israel Program for Scientific Translations, Ltd., Jerusalem.

OCEANOGRAPHIC CHARACTERIZATION DISRAELI FIORD (ELLESMERE ISLAND)

A. O. Shpaikher *In its* Probl. of the Arctic and the Antarctic 1970 p 511–518 refs (See N71-22801 11-13)

Copyright. Avail: NTIS HC$6.00/MF$0.95

In order to study the unusual distribution of the hydrological elements in Disraeli Fiord, 25 deep water hydrological stations were established during the summer of 1966. Of these, 8 stations were made from surface to bottom by standard methods using deep water tilting thermometers and bathometers. At 17 stations, the temperature and salinity were determined from the surface to a depth of 60 m by means of a salinothermographs. Current observations were also made by means of an Ekman flow gage at the main station. Comparison of data from the fiord and on the edge of the Ward Hunt self glacier showed that below the 100 m level, the variation of the temperature and salinity in the fiord and in the Arctic basin are the same. The striking difference in the hydrological conditions of the upper water layer is apparently a result of the thick ice dam; shelf glacier which blocks the exit from the fiord and upsets the water exchange between the surface layers of the Arctic basin and the fiord. A.L.

N71-22868# Israel Program for Scientific Translations, Ltd., Jerusalem.

ON THE RECENT INTERNATIONAL SEA ICE NOMENCLATURE

N. A. Volkov et al *In its* Probl. of the Arctic and the Antarctic 1970 p 519–524 (See N71-22801 11-13)

Copyright. Avail: NTIS HC$6.00/MF$0.95

Recommended changes submitted to the World Meteorological Organization on Abridged International Ice Nomenclature were based on the following principles: (1) The concepts and their definitions should be as lucid as possible and should not be repetitive in amount of ice descriptions at various depths. (2) Different nations may use their own ice terms, not included in the adopted nomenclature, but their information services' use of terms from the new nomenclature should be in strict conformity to definitions provided in the international nomenclature. (3) English language would be the working medium. (4) Proposals of new terms were rejected only when they had no significance for sea ice studies or duplicated and overlapped concepts already in the nomenclature. The recommended changes were approved by the World Meteorological Organization in August 1968, including a change in the name of the publication to International Sea Ice Nomenclature of the World Meteorological Organization. A.L.

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N71-21883# North Carolina State Univ., Raleigh.
EXTENSION OF SURVIVAL RANGE FOR DIFFRACTION GRATING STRAIN GAGES
Robert S. Steele, Robert A. Douglas, and Hans H. Stadelmaier Oct. 1970 30 p refs
(Contract N00014-68-A-0187)
(AD-717324; TR-70-7) Avail: NTIS CSCL 20/6

Diffraction grating strain gages cease to function when the surface is so roughened with strain that the gages no longer respond as coherent diffraction sources. A method is described by which the range of strains over which gages may be used, is extended significantly. This method requires incident radiation in a grazing - parallel attitude rather than the attitude normally employed in studying diffraction. A new diffraction equation is derived as are the equations which are necessary to calculate strain from an experimental configuration. The required changes to an existing test facility are discussed. Results obtained using this modified system demonstrate the improved range of the diffraction strain gage under dynamic straining. Author (GRA)

N71-21895# Naval Ordnance Lab., White Oak, Md.
THE ELECTROMAGNETIC VELOCITY GAGE AND APPLICATIONS TO THE MEASUREMENT OF PARTICLE VELOCITY IN PMMA
David J. Edwards, John O. Erkman, and Sigmund J. Jacobs 20 Jul. 1970 67 p refs
(AD-717346; NOLTR-70-79) Avail: NTIS CSCL 14/2

The electromagnetic velocity (EMV) gage was used to investigate particle velocity vs time and peak particle velocity vs distance at several points in PMMA (polymethylmethacrylate) in the donor-gap arrangement of the NOL Large Scale Gap Test. The results obtained by the method agree favorably with previously measured peak particle velocities for gap distances from the HE-PMMA interface between 10 and 25 mm. At closer distances the particle velocity-time records are in good relative agreement with one dimensional hydrodynamic computations. The values of peak particle velocity found for distances less than 5 mm are not in agreement with the previous extrapolation to zero gap of the earlier data obtained for gaps > or = 10 mm. Consequently, a new tentative calibration for the close-in distance is presented. The study encountered a number of recording problems; noise in the records and poor system response. Steps taken to eliminate the noise and to improve the recording response are outlined. Also discussed are the theoretical behavior of the gage, factors influencing systems response, and comparison of real with predicted response. It was concluded that the EMV gage is a convenient and useful tool for measuring particle velocity vs time in non-conducting or weakly conducting media. Author (GRA)

N71-21930# Westington Research Labs., Pittsburgh, Pa.
AN INVESTIGATION OF FRACTURE BY THE USE OF MICROSTRAIN GAUGES Interim Technical Report, 1 Feb. 1970 - 31 Jan. 1971
J. Bevil and P. I. Shaw 31 Jan. 1971 17 p refs
(Contract N00014-70-C-0163)
(AD-717649; Rept-71-9D2-TWINN-R1) Avail: NTIS CSCL 14/2

Experimental techniques for the fabrication of a piezoelectric strain gauge device are described. ZnS films vapor deposited on a tensile specimen are capable of giving strain measurements of .0000001 inches/inches and have a time resolution of .00000001 sec. Author (GRA)

N71-21931*# Rensselaer Polytechnic Inst., Troy, N.Y.
CHROMATOGRAPHIC TEST FACILITY. ANALYSIS AND DESIGN OF A CAPSULE LANDING SYSTEM AND SURFACE VEHICLE CONTROL SYSTEM FOR MARS EXPLORATION
Steven R. Baer and Gordon L. Benoit Mar. 1971 42 p refs
(Grant NGL-33-018-091)
(NASA-CR-117468; RPI-TR-MP-19) Avail: NTIS CSCL 14B

The initial unmanned missions to Mars will require a gas chromatograph/mass spectrometer system to make determinations concerning the existence of certain chemical and biochemical species on the planet. The overall objective of the research is to generate fundamental engineering design techniques and concepts for use in optimizing the design of the chromatograph. The investigation reported is aimed at the building of a test facility for use in verifying the mathematical models of the chromatograph, for obtaining chromatographic data, and for testing possible system concepts. A previously used commercial chromatographic system was rejuvenated and modified. New features include a pair of micro-thermal conductivity detectors for monitoring inlet and outlet gas compositions, an improved system for reproducibly injecting gas and liquid samples, and an oscillograph for recording data. To obtain accurate recordings of the transient behavior of the gas composition, the system dynamics were improved by reducing detector time constants and dead volume within the piping. The system was completed and is being used to obtain chromatographic data. Author

N71-21969# Naval Intelligence Command, Alexandria, Va. Translation Div.
A HIGHLY EFFICIENT NEUTRON DETECTOR [VYSOKOEFFEKTIVNYI NEITRONNYI DETEKTOR]
B. S. Ishkhanov et al 21 Jan. 1971 7 p refs Transl. into ENGLISH from Pribory i Tekhn. Eksperim. (Moscow), no. 6, 1969 p 59-61
(AD-717402; NIC-TRANS-3161) Avail: NTIS CSCL 18/4

A description is given of a highly efficient neutron detector in which the efficiency of neutron registration is weakly dependent on the initial energy level of the neutrons. The detector efficiency is about 45%. Cross sections of photoneutron reactions in a series of isotopes were obtained using the detector. Author (GRA)

N71-21972# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE QUESTION OF STRUCTURAL DAMPING IN GYROSCOPIC SYSTEMS
A. A. Potapov 1970 3 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Priborostr. (USSR), no. 11, 1970 p 75-78
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

A three degree of freedom gyroscope with a structural damping force (SDF) source in the gyroscope housing is considered. By using methods of the applied theory of elastic vibrations, expressions are obtained to take account of the SDF in the equations of gyroscope motion for arbitrary construction of the linkage. Author

N71-21887# Max-Planck-Institut fur Aeronomie, Lindau uber Northeim (West Germany). Inst. fuer Stratosphaerenphysik.
FUNCTIONAL AND ENVIRONMENTAL TEST METHODS APPLIED TO COMPONENTS IN SPACE FLIGHT [TEST- UND PRUEFMETHODEN BEI RAUMFAHRTGERAETEN]
E. Keppler Bad Godesberg, West Ger. Bundesmin. fuer Bildung und Wiss Nov. 1970 54 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Bildung und Wiss. (BMBW-FB-W-70-63) Avail: NTIS; ZLDI Munich: 11 DM

Functional and environmental test methods which usually are applied to components to be flown on satellites are described and discussed. Reliability considerations are compared with results obtained during satellite testings. Some results obtained during the Azur program are also shown. Author (ESRO)

N71-21982# European Space Research and Technology Center, Noordwijk (Netherlands). Space Science Dept.
THE ELECTRON ENERGY DISTRIBUTION WITHIN A CURVED CHANNEL MULTIPLIER
R. D. Andresen, S. T. Ho, and D. E. Page 1971 12 p refs Submitted for publication
Avail: NTIS

The energy distribution of electrons leaving a curved channel multiplier has been experimentally determined. There exists a peaked distribution for relatively low voltages (V sub 0) applied to the channel multiplier. The mean electron energy shows an approximately V sub 0 to the 2/3rd power dependency as predicted by theory. Author (ESRO)

N71-22025*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
PROTOTYPE AIRBORNE ONE-THIRD OCTAVE BAND SPECTRUM ANALYZER FOR ACOUSTIC AND VIBRATION DATA
Apr. 1971 63 p refs
(Contract NAS1-10165)
(NASA-CR-111860; BBN-2068) Avail: NTIS CSCL 14B

The design of a compact frequency analyzer for measurement and analysis onboard flight vehicles is discussed. By the use of such an analyzer, wideband data can be analyzed onboard, thus substantially reducing the bandwidth requirements on the telemetry links. The analyzer was breadboarded in a partial third-octave band configuration with eight filters and detectors spaced by the square root of 10 from 100 Hz to 200,000 Hz. The analyzer has been tested over a temperature range of 40 to 120 F, and has demonstrated at least 60 dB of dynamic range. The test results are included. Author

N71-22057# Joint Publications Research Service, Washington, D.C.
PHOTOELECTRIC GAS ANALYZERS
G. I. Kryukov et al *In its* Atmospheric Studies at Chem. Enterprises 9 Mar. 1971 p 23-38 refs (See N71-22055 11-13)
Avail: NTIS

Photocolorimetric gas analysis technology is reviewed. Parameters of direct conversion, differential, and compensation photometers are discussed, and the operating characteristics of foreign and Soviet photocolorimetric gas analyzers are tabulated. The use of these instruments for analyzing toxic agent microconcentration in the vicinity of industrial plants is determined to be feasible. E.C.

N71-22058# Joint Publications Research Service, Washington, D.C.
ELECTROCHEMICAL GAS ANALYZERS FOR ANALYZING TOXIC AGENTS IN THE AIR
V. Z. Alperin et al *In its* Atmospheric Studies at Chem. Enterprises 9 Mar. 1971 p 39-52 refs (See N71-22055 11-13)
Avail: NTIS

The features of conductometric, polarographic, and coulometric gas analyzers are summarized. The effectiveness of the polarographic and coulometric methods in air pollution analyses is emphasized. E. C.

N71-22063# Joint Publications Research Service, Washington, D.C.
APPLICATION OF THE METHOD OF INFRARED ABSORPTION IN ANALYZING MICROADMIXTURES OF HARMFUL AGENTS IN THE AIR
I. V. Korablev et al *In its* Atmospheric Studies at Chem. Enterprises 9 Mar. 1971 p 119-130 refs (See N71-22055 11-13)
Avail: NTIS

Methods and equipment for electromagnetic absorption spectra gas analysis are considered. Techniques for increasing the selectivity and sensitivity of gas analyzers are discussed. The operating characteristics of single and dual beam optical-acoustic gas analyzers are reviewed. E.C.

N71-22071# European Space Research and Technology Center, Noordwijk (Netherlands). Space Science Dept.
THE SIDE EFFICIENCY OF THE CHANNEL MULTIPLIER FOR 50 MeV PROTONS
R. D. Andresen and D. E. Page 1970 6 p Submitted for publication
Avail: NTIS

The ability of a channel multiplier to record radiation incident through its side walls has been studied using 50 MeV protons at the cyclotron of the Institute for Nuclear Research (IKO), Amsterdam. The results indicate that about 25 percent of the total length nearest to the low potential open end of a curved channel multiplier is sensitive to this radiation. Author (ESRO)

N71-22076 California Univ., Berkeley.
TIME RESOLVED SCANNING ELECTRON MICROSCOPY AND ITS APPLICATION TO GUNN EFFECT OSCILLATORS
Gary York Robinson (Ph.D. Thesis) 1969 135 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 70-6201

A new experimental technique for studying time dependent phenomena in a scanning electron microscope is discussed. The technique is shown to be particularly useful for the examination of time varying potential distributions over the surface of solid state devices. Using a system with a bandwidth of over 1 GHz, a study of the motion of high field domains in Gunn effect oscillators is presented to demonstrate time-resolved scanning electron microscopy. Dissert. Abstr.

N71-22097# Lockheed Missiles and Space Co., Palo Alto, Calif.
DYNAMIC CHARACTERISTICS OF A TWO DEGREE OF FREEDOM GYROSCOPE WITH POSITION INTEGRAL NEGATIVE FEEDBACK
G. M. Davidenko 1970 3 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Priborostr. (USSR), v. 13, no. 12, 1970 p 62-65
Avail: NTIS: National Translations Center, John Crerar Library, Chicago, Ill. 60616

The dynamic characteristics of the gyroscope are studied theoretically and experimentally. It is shown that the amplitude-frequency characteristics possess two maximums. Means of perfecting these type of instruments are discussed. Conclusions

indicate that: (1) A two degree of freedom gyroscope with position and integral negative feedbacks can have two natural frequencies, a low (2 to 4 Hz) and a high (10 to 20 Hz), which limits application of such devices. (2) To annihilate the low natural frequency it is necessary either to attenuate the integral feedback, or to use a noninertial electronic integrator. Author

N71-22135*# Lockheed Missiles and Space Co., Palo Alto, Calif. Research Lab.
SIX CHANNEL PHOTOMETRIC OBSERVATIONS FROM THE CV990 AIRCRAFT Final Report
S. B. Mende and R. H. Eather 26 Jun. 1970 36 p refs
(Contract NASw-1997)
(NASA-CR-117466; LMSC/N-AR-70-1) Avail: NTIS CSCL 14E

An investigation of the spatial extent of aurorae was undertaken from College, Alaska, by the ground based television two channel (5577A and 4278A) image intensifier system and with a multichannel boresighted tilting filter photometer. The measurements indicate that even on clear nights the extinction due to scattering in the 4278A is significant unless the measurements are taken at small zenith angles. To confirm the results and to avoid the low altitude scattering problem, measurements were made on a quite arc with the 6 channel tilting filter zenith photometer during the NASA CV 990 expedition. These results show that in the cases observed there was no significant difference between the latitude profiles of O(5577) and N2(4278) emissions. Author

N71-22155*# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
PRESSURE SENSING CONTROL DEVELOPMENT FOR PRESSURIZATION AND VENTING SYSTEMS Final Report, 2 Jul. 1969 – 2 Aug. 1970
W. J. Wachtler and J. Tobloski Mar. 1971 211 p
(Contract NAS3-13310)
(NASA-CR-72748; MDC-G0933) Avail: NTIS CSCL 14B

A technology program is discussed in which a hybrid (analog/digital) electronic controller is developed. The controller is designed to provide propellant tank pressurization control during engine operation and tank venting during standby for a cryogenic space propulsion system requiring multiburn operations and long cost times. The system also solves the problem of true net positive suction pressure (NPSP) control. The total program encompassed analysis, design, fabrication, and testing. The analysis includes the assessed benefits of true NPSP control and accuracy requirements. The developed system performed essentially as designed under environmental test conditions. Author

N71-22165# New York Univ., N.Y. Geophysical Sciences Lab.
AN INVESTIGATION OF INSTRUMENTATION AND TECHNIQUES FOR OBSERVING TURBULENCE IN AND ABOVE THE OCEAN BOTTOM BOUNDARY LAYER
Henry R. Frey Dec. 1970 104 p refs
(Contract Nonr-285(57))
(AD-717638; GSL-TR-70-16) Avail: NTIS CSCL 8/3

Calibrations of Flow Corporation conical hot platinum film probes indicate a downward shift in sensitivity due to film deterioration, a sudden increase in cold increase preceding catastrophic failure, a one-third greater radial than axial sensitivity, ambiguities in the value of the exponent n in Kings Law, and a maximum life of 20.5 hours. Field experience indicates poor reliability and an inordinate amount of necessary experimental precautions. A stereophotogrammetric current meter prototype is described. With modifications, the prototype holds promise for Lagrangian velocity field observations. Two Hydro-Products Model 465-A current direction sensors were examined for biases introduced by frictional coupling. Negative deviations were obtained for clockwise rotations of the vane relative to the housing, and positive deviations were obtained when the housing was rotated in the same relative sense. Bottom-mounted apparatus and a mooring station off Race Point, Cape Cod are described. Vertical current profiles displayed large variations in form. Author (GRA)

N71-22229# Boeing Scientific Research Labs., Seattle, Wash. Materials Sciences Lab.
ELECTRON SPECTROMETER FOR SURFACE ANALYSIS
P. S. P. Wei and A. W. Smith Nov. 1970 39 p refs
(AD-717280; D1-82-1021) Avail: NTIS CSCL 14/2

An electron spectrometer of the LEED-Auger type was installed in the authors laboratory. The principle of operation, the significance of the measurements and possible applications are described. The capabilities of the technique are demonstrated by studying the clean and gas-covered silicon (111) surface. The results suggest that the spectrometer is a sensitive and versatile instrument for the analysis of surface composition, structure and properties. Author (GRA)

N71-22261# Israel Program for Scientific Translations, Ltd., Jerusalem.
GAMMA SPECTROMETRY OF NATURAL ENVIRONMENTS AND FORMATIONS: THEORY OF THE METHOD APPLICATIONS TO GEOLOGY AND GEOPHYSICS
R. M. Kogan et al 1971 320 p refs Transl. into ENGLISH of the publ'Osnovy Gamma-Spektrometrii Prirodnykh Sred. Teoriya Metoda Gamma-Spektrometrii i Geologo-Geofizicheskie Prilozheniya' Moscow, Atomizdat., 1969 Supported by ESSA and NSF
(TT-70-50092) Copyright. Avail: NTIS HC$6.00/MF$0.95

The nuclear gamma rays emitted upon relaxation of the excited state of atomic nuclei have discrete, line spectra. This spectrum is characteristic of the nucleus (in analogy to the optical spectra of atoms and molecules). The product nucleus of radioactive decay is often found in an excited state, and thus, proceeding from the initial discrete spectrum of nuclear gamma rays, the isotopic composition and quantity of such radioactive nuclei can be determined. In addition, the initial spectrum is altered by passage of the radiation through the ambient medium, the degree of absorption and scattering of the quanta being determined by the atomic composition of the absorber and the distance from the radiation source. Thus, observations on gamma rays determine certain properties of the absorbing medium. The above-mentioned approaches to the study of natural media (i.e., the gamma spectrometry of these media) have seen very widespread application during the last fifteen years. New knowledge has thereby been gained on the natural and artificial radioisotope content of natural media, and very convenient methods for effecting such measurements have been developed. Author

N71-22262# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE POSSIBILITY OF CONSTRUCTING AN INVARIANT GYROCOMPASS WITH PENDULUM CORRECTION
E. I. Sliv 1970 3 p ref Transl. into ENGLISH from Priborostroenie (Moscow), v. 13, no. 11, 1970 p 79–81
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

A gyrocompass with pendulum correction is examined. It is shown that the equations of its motion agree completely with the equations of motion of a pendulum compass, whose invariance has been shown exhaustively in the literature. A curious phenomenon is observed in such systems, the pendulum is mounted in the direction of the apparent vertical, while the gyrohorizon is in the plane of the geocentric horizon throughout the whole motion. A gyrocompass may also be constructed according to this principle. Author

N71-22454# National Bureau of Standards, Washington, D.C.
FIELD TESTS OF SEVERAL FOG DETECTOR SYSTEMS

J. C. Wilkerson, James E. Davis, and J. W. Simeroth [1970] 43 p
(NBS-10186) Avail: NTIS

Four fog-detecting instrument systems were field tested. The tests were intended to determine the suitability of the instruments for use as fog detectors. The test periods differed for each of the four instruments, extending from 6 months to 18 months. All instruments were installed in the field and evaluated for performance in natural atmospheric conditions. Of the four instrument systems tested, two were found suitable for detecting fog and operating fog warning devices at preselected levels of transmittance for periods of several months without malfunctions. The other two systems were not satisfactory in their present form for this purpose because the sensitivity decreased excessively. Author

N71-22458# National Bureau of Standards, Washington, D.C.
OPERATIONAL TESTS OF DUAL BASELINE TRANSMISSOMETER SYSTEMS
J. C. Wilkerson, J. W. Simeroth, and James E. Davis 15 Sep. 1970 14 p
(NBS-10339) Avail: NTIS

A Skopograph Duplex dual-baseline transmissometer system was installed and operated for four months to determine operational performance of the system. A system of standard transmissometers with similar baselines was placed beside the test system to provide data for comparison. The output data from both systems were recorded photographically by a special photo-pack. The Skopograph equipment operated through the test period with no failures. The most important maintenance requirement was the need for cleaning the windows of the field units approximately twice each week. Several features of the performance and records that could require special treatment in processing the data and evaluating the performance are discussed. Author

N71-22479# Edgerton, Germeshausen and Grier, Inc., Bedford, Mass.
OPTIMIZATION OF IMAGE LOCATION RELATIVE TO ROTOR SURFACE MODEL 739 FRAMING CAMERA
Arthur Pierson Jun. 1970 11 p Prepared for Calif. Univ., Livermore. Lawrence Radiation Lab.
(Contract AT(29-1)-1183)
(EGG-1183-542) Avail: NTIS

Criteria for minimizing in frame motion for a model 739 framing camera, whose mirror does not have zero thickness and axis of rotation is not coincident with the surface, are investigated. An evaluation and results are included. Author

N71-22599 National Bureau of Standards, Washington, D.C.
A STUDY OF STABILITY OF HIGH TEMPERATURE PLATINUM RESISTANCE THERMOMETERS
J. P. Evans and G. W. Burns *In* AGARD Meas. Tech. in Heat Transfer Nov. 1970 p 63–73 refs (See N71-22596 11-33)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

Electrical resistance measurements of several thermometers over a temperature range between 500 C and 1100 C are discussed. From time to time the thermometers were removed from the furnace for determination of the resistance at 0 C and the ratio of the resistances at 100 C and 0 C. The studies show that stable, high temperature platinum resistance thermometers can be made and that stability is dependent on the rate at which the thermometers are cooled from temperatures above 600 C. N.E.N.

N71-22611 Thermo-Systems, Inc., St. Paul, Minn.
OPERATION AND APPLICATION OF COOLED FILM SENSORS FOR MEASUREMENTS IN HIGH TEMPERATURE GASES
L. M. Fingerson and A. M. Ahmed (McGill Univ.) *In* AGARD Meas. Tech. in Heat Transfer Nov. 1970 p 487–504 refs (See N71-22596 11-33) Prepared jointly by Thermo-Systems, Inc., St. Paul and McGill Univ.
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The cooled film sensor is a device permitting measurements in high temperature environments similar to those obtainable at normal temperatures with a hot wire anemometer. The limitations of the technique both in maximum environment conditions and accuracy are discussed. In addition, typical measurements and some special techniques that can be applied are presented. Optimum applications of the cooled film anemometer include environments where transient phenomena are to be measured and where the maximum heat transfer to the sensor (0.15 mm dia. by 1.5 mm long) is less than 10 watts. Up to 20 watts is possible for short term tests. Author

N71-22642 Universitaets-Sternwarte Goettingen (West Germany). Inst. fuer Physikalische Chemie.
INVESTIGATION OF REACTING GASES WITH THE MASS SPECTROMETER
K. H. Homann *In* AGARD New Exptl. Tech. in Propulsion and Energetics Res. Oct. 1970 p 369–382 refs (See N71-22626 11-12)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The application of mass spectrometric analysis together with suitable methods of sampling from reacting gases is reviewed. The question as to how well a sample is representative for the stage of reaction is discussed for microprobe sampling of stable products and molecular beam sampling for free radicals and active atoms. A supersonic nozzle as source for a molecular beam was used for sampling from flames and isothermal flow systems at pressures ranging from a few mm Hg to more than one atmosphere. The gas temperature effects on the mass spectra and the identification and analysis of free radicals and atoms are illustrated by examples. Author

N71-22655 Sun Oil Co., Marcus Hook, Pa.
GAS CHROMATOGRAPHY
J. L. Lauer *In* AGARD New Exptl. Tech. in Propulsion and Energetics Res. Oct. 1970 p 595–625 refs (See N71-22626 11-12)
Copyright. Avail: Technivision, Graywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The retention times of a particular column are shown to be characteristic of various physicochemical properties of the material in the column. Gas chromatography is also automated and made very fast and sensitive in the parts-per-million-and-below range. Author

N71-22677*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A SCALING TECHNIQUE FOR AIR-BEARING SIMULATION OF PRECISION POINTING SYSTEMS
Gordon F. Bullock and Frederick R. Morrell Washington Apr. 1971 18 p refs
(NASA-TN-D-6197; L-7532) Avail: NTIS CSCL 14B

A scaling technique which can be used to simplify the laboratory simulation of the precision pointing system for a large space telescope is presented for the single-axis case. It is shown that the dynamic response of the scaled and unscaled control systems can be maintained the same by suitable scaling of the vehicle inertia, disturbance torque, and the attitude rate and position loops. The control system for the telescope consists of a

single-axis, twin-rotor control moment gyroscope as the momentum exchange device, and a high-gain position loop including a star sensor. Experimental results from an air-bearing simulation of the pitch-axis precision pointing system for three different scale factors demonstrate the validity of the scaling technique. Author

N71-22678*# National Bureau of Standards, Washington, D.C.
DEVELOPMENT OF TEST FACILITIES. NOBLE METAL THERMOCOUPLE RESEARCH PROGRAM 1000-2000 C Summary Report
P. Freeze, D. Thomas, S. Edelman, and J. Stern Jan. 1971 36 p refs
(NASA Order C-46191-B; NBS Proj. 4253439)
(NASA-CR-72861; NBS-4253439) Avail: NTIS CSCL 14B

Three performance characteristics of noble metal thermocouples in oxidizing media, such as air and air containing various unburned gases are considered. An investigation of the effects from catalysis on platinum wires in a low velocity facility, indicated significant effects from certain gas mixtures. The concentration of the unburned gases in a mixture, flow rate, and wire diameter contribute significantly to the size of the error. Preliminary results obtained in the high velocity test system show catalysis continues to be a source of error at increased velocities of 20 to 90 meters per second. A thermoelectric stability study of the iridium-40% rhodium versus iridium thermocouple system at temperatures up to 2000 C in oxidizing media such as air was also investigated. The effects of large and small temperature gradients on the accuracy and stability of thermocouple measurements were determined. Author

N71-22746 Pittsburgh Univ., Pa.
A NEW HEAT FLUX MEASURING SYSTEM
Richard Ernest Wendt (Ph.D. Thesis) 1969 118 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 70-7883

Thermally sensitive electrical effects are reviewed in the light of their potential for responding to heat flow or to a temperature differential. It is shown that an instrument could be based on thermistors with exponential temperature dependence, and a method is developed for realizing such thermistors in doped polycrystalline ceramics, such as barium-strontium titanate, showing the ferroelectric resistance anomaly. Signal conditioning circuitry for such sensors operates on the ratio of two thermistor resistances, a measurement which can be made with great sensitivity and accuracy with simple apparatus. By empirical analog computation it is possible to show how a rectangular distribution of critical temperatures of individual ceramic grains leads to the desired exponential resistance temperature characteristic. The fabrication and testing of successful demonstration sensors is described as additional support of the theories developed. Dissert. Abstr.

N71-22752* Astro-Space Labs., Inc., Huntsville, Ala.
LINEAR DIFFERENTIAL PRESSURE SENSOR Patent
Aaron G. Loughead and James F. Milliken, inventors (to NASA) Issued 21 May 1968 (Filed 27 Jul. 1966) 7 p Cl. 73-419 Sponsored by NASA
(NASA-Case-XMF-01974; US-Patent-3,383,922; US-Patent-Appl-SN-568354) Avail: US Patent Office CSCL 14B

A linear differential pressure sensor for measuring differential pressures of a few pounds per square inch is described. Two pressures are applied to opposite ends of a piston of known mass, free to move along the axis of a hollow receptacle. Tilt mechanisms are provided for supporting and varying the angle of inclination of the receptacle in accordance with the control signal. Readout means are connected to the tilt mechanisms for providing a signal which varies directly with the sine of the angle of inclination necessary to balance the forces acting on the slide. The difference in pressure between the first and second pressure is a linear function of the sine of this angle of inclination. Official Gazette of the U.S. Patent Office

N71-22760 California Univ., Los Angeles.
THE DESIGN OF A HIGH-RATE CHARGED PARTICLE DETECTION INSTRUMENT FOR USE ON THE SMALL SCIENTIFIC SATELLITE
Alan Jeffrey Eskovitz (Ph.D. Thesis) 1969 169 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 70-9924

The system and circuit design of a high rate charged particle experiment for use on the Small Scientific Satellite is presented. The instrument is designed to measure the directional intensity of electrons (40 keV-500 keV) and protons (440 keV to 1.5 meV). In order to obtain measurements with low statistical uncertainty the instrument has been designed to achieve very high counting rates through the use of large detector geometrical factors and high speed electronics. The electron detector consists of a high speed, low noise, two inch diameter photomultiplier tube with a thin plastic scintillator covered by a 20 microinch nickel foil light shield. The tube is operated at a low average anode current to avoid fatigue effects upon its gain during the one year spacecraft lifetime. The proton detector consists of a thin (24 micron) completely depleted silicon surface barrier detector of 1 sq cm area. Dissert. Abstr.

N71-22765* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LUNAR PENETROMETER Patent
George W. Brooks, John L. McCarthy, and Alfred G. Beswick Issued 5 Sep. 1967 (Filed 26 Nov. 1963) 10 p Cl. 73-84
(NASA-Case-XLA-00934; US-Patent-3,339,404; US-Patent-Appl-SN-326298) Avail: US Patent Office CSCL 14B

A penetrometer for measuring the physical properties of the lunar surface is described. The device consists of an accelerometer which impacts on the surface and transmits the developed impact acceleration time history to a remote point. The received impact acceleration data is compared with known acceleration time histories for various earth materials to determine the physical properties of the surface such as surface hardness, bearing strength, and penetrability of the body. P.N.F.

N71-22869*# Perkin-Elmer Corp., Pomona, Calif. Aerospace Div.
COMBINED STUDY PROGRAM. VOLUME 1: CARBON MONOXIDE ACCUMULATOR CELL STUDY Final Report
Mary Rotheram Mar. 1971 111 p
(Contract NAS1-9469)
(NASA-CR-111855; SPO-30006-Vol-1) Avail: NTIS CSCL 14B

An instrument system concept was studied to optimize the application of a mass spectrometer as a sensor for monitoring the primary atmospheric constituents, as well as atmospheric contaminants, onboard a manned spacecraft. The program was divided into six studies representing the primary system parts complementing the spectrometer: a carbon monoxide accumulator cell, an ion pump, an ion pump power supply, an inlet leak, an ion source, and an undersea atmospheric analyzer. The principle goal of the combined study program was the achievement of an instrument concept of minimum power, weight, and size without compromising the minimum detection limits. Author

N71-22872*# Perkin-Elmer Corp., Pomona, Calif. Aerospace Div.
COMBINED STUDY PROGRAM. VOLUME 4: INLET LEAK STUDY Final Report
G. V. Moore Mar. 1971 47 p refs
(Contract NAS1-9496)
(NASA-CR-111858; SPO-30006-Vol-4) Avail: NTIS CSCL 14B

The goal of the direct entry inlet lead development was

to provide a molecular flow of sample gas from a sample environment of approximately one-half to one atmosphere into the mass spectrometer ion source, at a maximum pressure of about 0.0002 torr. The advantage of such a system is that it requires no auxiliary pump, such as that required for the existing capillary line pressure divider system. Molecular flow assures a linear relation between the pressure in the ion source and the pressure in the sample environment; and molecular flow allows each of the constituents in the sample gas mixture to flow independently of each other when they enter the ion source. As a result, the measurement of one constituent in the mixture is not affected by the amount of the other components that are present. Author

N71-22873*# Perkin-Elmer Corp., Pomona, Calif. Aerospace Div.
COMBINED STUDY PROGRAM. VOLUME 5: DIRECT ENTRY ACCUMULATOR CELL MOLECULAR BEAM ION SOURCE Final Report
Mary Rotheram Mar. 1971 54 p refs
(Contract NAS1-9469)
(NASA-CR-111859; SPO-30006-Vol-5) Avail: NTIS CSCL 14B

The physical requirements of the direct entry ion source, in particular the array of sample inlet tubes, appear to be feasible and the pressures involved in the inlet system ahead of the sample inlet tubes are compatible with accumulator cell operation. Principles involved in the design of an inlet system for trace contaminant analysis with the accumulator cell concept were reviewed. Design of a system that does not require a bypass pumping line was shown to be feasible if some means can be provided for reducing the cell pressure from atmospheric to about two-tenths of a torr. System performance was considered and it appears that sensitivity comparable to that obtained in a laboratory contaminant sensor system, one-tenth to ten parts per million, could be realized. Author

N71-22984* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THERMAL SHOCK APPARATUS Patent
Alan Arias, inventor (to NASA) Issued 30 Jan. 1968 (Filed 29 Dec. 1964) 5 p Cl. 73-15
(NASA-Case-XLE-02024; US-Patent-3,365,930;
US-Patent-Appl-SN-422099) Avail: US Patent Office CSCL 14B

An apparatus for measuring the thermal shock resistance of thin discs of material samples by heating and insulating the faces of the discs and thereafter cooling the peripheries of the discs with a cooling fluid is described. The invention also relates to apparatus for methods of quantitatively determining thermal-shock resistance properties of relatively brittle materials such as glass, beryllium oxide, aluminum oxide, and zirconium oxide or for determining the surface heat transfer coefficient of quenching media (both liquids and gases) or for estimating the thermal diffusivity and thermal conductivity of a disc of material.
Official Gazette of the U.S. Patent Office

N71-22985* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PRECISION THRUST GAGE Patent
Daniel J. Grant, inventor (to NASA) Issued 30 Jan. 1968 (Filed 14 Oct. 1965) 5 p Cl. 73-117
(NASA-Case-XGS-02319; US-Patent-3,365,941;
US-Patent-Appl-SN-496205) Avail: US Patent Office CSCL 14B

A temperature compensated thrust measuring gage for accurately measuring forces as a function of time in an environment whose temperature varies as a function of time is discussed. The gage includes a column comprising a pair of legs and a leg connecting portion for connecting the legs at one end and for providing the means to which the device to be tested is mounted. The legs are each spaced an equi-distant from and symmetrical with a reference plane with each having its other end affixedly attached to a supporting base. A pair of capacitance transducers are located in operable proximity with the legs to sense the displacement thereof, and an adjustable fluid damping assembly is provided to cooperate with the column to insure optimum response for the type of force-time characteristics to be measured.
Official Gazette of the U.S. Patent Office

N71-22989* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HEAT SENSING INSTRUMENT Patent
Howard B. Miller and William D. Harvey, inventors (to NASA) Issued 14 May 1968 (Filed 29 Dec. 1964) 3 p 73-190
(NASA-Case-XLA-01551; US-Patent-3,382,714;
US-Patent-Appl-SN-422092) Avail: US Patent Office CSCL 14B

A device is described for sensing infinitesimal amounts of heat flowing onto a surface at several locations. A support body having several holes drilled in it has a sheet of heat conducting material bonded to it. A thermocouple junction is connected to the underside of the sheet for heat detection.
Official Gazette of the U.S. Patent Office

N71-22990* Electro-Optical Systems, Inc., Pasadena, Calif.
ARTICLE DETECTION APPARATUS INCLUDING A BALLISTIC PENDULUM Patent
Leonard M. Snyder, inventor (to NASA) Issued 23 Apr. 1968 (Filed 10 Nov. 1965) 7 p 324-70 Sponsored by NASA
(NASA-Case-XMS-04201; US-Patent-3,379,974;
US-Patent-Appl-SN-507254) Avail US Patent Office CSCL 14B

An apparatus for measuring the momentum and velocity of minute space particles is described. The analyzer is adapted to directly measure momentum, scalar, and vector components of the velocity of space particles from their collisions with a ballistic pendulum. Official Gazette of the U.S. Patent Office

N71-22991* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ABLATION SENSOR Patent
Archibald R. Sinclair and James M. Russell, III Issued 13 Aug. 1968 (Filed 9 Jun. 1965) 5 p Cl. 250-227
(NASA-Case-XLA-01791; US-Patent-3,397,318;
US-Patent-Appl-SN-462763) Avail: US Patent Office CSCL 14B

A sensor for measuring the rate of ablation and the temperature of an ablation material on the surface of a vehicle reentering the atmosphere from space is described. Light pipes are embedded in the surface of the ablation at various levels. When the ablation material burns to the successive level of the light pipes, the incandescence of the burning is conveyed through the light pipes to photo-sensors whose outputs are indictive of the burning rate. Calibration of the output also provides a temperature reading at the area of charring.
Official Gazette of the U.S. Patent Office

N71-22992* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MOMENT OF INERTIA TEST FIXTURE Patent
Joseph H. Conn, inventor (to NASA) Issued 16 Apr. 1968 (Filed 6 Apr. 1965) 5 p Cl. 73-65
(NASA-Case-XGS-01023; US-Patent-3,377,845;
US-Patent-Appl-SN-448131) Avail: US Patent Office CSCL 14B

A test fixture to enable the moment of inertia of a complex, irregularly shaped body to be determined about mutually perpendicular axes without the rotation of the axes of the body, which employs a long, thin suspension rod rigidly fixed to a reference surface at one and and to the test body at the other end, is described. For making measurements with respect to one axis by the pendulum method, the reference surface is suspended from bearings such that the rod and the test body are free to move as a simple pendulum. To make measurements about an axis

perpendicular to the suspension rod by the torque method, means are provided to prevent movement as a simple pendulum to also enable the test body to oscillate about the longitudinal axis of the suspension rod. Official Gazette of the U.S. Patent Office

N71-22993* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

PHONOCARDIOGRAPH TRANSDUCER Patent

William J. Young, inventor (to NASA) Issued 4 Jun. 1968 (Filed 21 Dec. 1965) 3 p Cl. 310-8.5

(NASA-Case-XMS-05365; US-Patent-3,387,149; US-Patent-Appl-SN-515484) Avail: US Patent Office CSCL 14B

A piezoelectric transducer for monitoring sound waves of physiological origin is described. The device is characterized by a nylon housing having a bore which provides an annular shelf which supports a piezoelectric plate at diagonally opposed points of the plate. Conductor leads are secured to both faces of the plate in a manner such that no conductor is in electrical contact with the subject. A resistor for determining low frequency response is electrically connected in parallel with the plate and mounted within the housing directly over the plate to reduce noise pickup. A first flexible potting compound placed directly over the plate fixes the resistor relative to the plate and insulates the circuit from moisture but does not hinder the low frequency vibrating characteristics of the plate. A second less flexible epoxy compound laid over the first potting compound is resistant to mechanical shock and is thermally and electrically insulative.

Official Gazette of the U.S. Patent Office

N71-22995* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

FRICTION MEASURING APPARATUS Patent

Warren G. Clement and Pleasant T. Cole, inventors (to NASA) Issued 9 Apr. 1968 (Filed 29 Jun. 1966) 4 p Cl. 73-9 Sponsored by NASA

(NASA-Case-XNP-08680; US-Patent-3,376,730; US-Patent-Appl-SN-562444) Avail: US Patent Office CSCL 14B

An apparatus for measuring the static friction between the surfaces of a magnetic tape and a magnetic head is described. The apparatus includes means for mounting a magnetic head in a substantially fixed position. Power means are provided for pulling the tape across the head with the tape surface contacting the head surface. A cantilevered leaf spring is provided, whose free end either supports the magnetic head or is secured to one end of the magnetic tape. As the tape is pulled across the head, the leaf spring will flex by an amount related to the friction between the tape and head. The flexure in the leaf spring is determined by a strain gauge. Official Gazette of the U.S. Patent Office

N71-22996* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

FLUID FLOW METER WITH COMPARATOR REFERENCE MEANS Patent

Daniel J. Grant, inventor (to NASA) Issued 11 Jun. 1968 (Filed 5 Apr. 1965) 8 p Cl. 250-218

(NASA-Case-XGS-01331; US-Patent-3,388,258; US-Patent-Appl-SN-445807) Avail: US Patent Office CSCL 14B

A photometric flow meter, which provides an accurate indication of both the fluid flow and fluid displacement by tracking the meniscus of a fluid as its level changes within a dispensing tube, is described. The meter also indicates the total fluid flow from a reference point, total flow and flow rate, and the quantity of the fluid dispensed. The meter is also susceptible to remote control. Official Gazette of the U.S. Patent Office

N71-23038* General Dynamics/Astronautics, San Diego, Calif.

PRESSURE TRANSDUCER CALIBRATOR Patent

Frank J. Bogusz, inventor (to NASA) Issued 21 May 1968 (Filed 10 Jan. 1966) 5 p Cl. 73-4 Sponsored by NASA

(NASA-Case-XNP-01660; US-Patent-3,383,903; US-Patent-Appl-SN-578916) Avail: US Patent Office CSCL 14B

A calibrating transducer which may be coupled to a pressure measuring transducer and left coupled while the pressure measuring transducer is functioning is described. Fluid under pressure which is to be measured, is supplied to both the calibrating transducer and the measuring transducer whereby calibration occurs under actual working conditions.

Official Gazette of the U.S. Patent Office

N71-23037* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

HALL CURRENT MEASURING APPARATUS HAVING A SERIES RESISTOR FOR TEMPERATURE COMPENSATION Patent

Ralph T. Hood, inventor (to NASA) Issued 23 Jan. 1968 (Filed 27 Jul. 1964) 4 p Cl. 324-117

(NASA-Case-XAC-01662; US-Patent-3,365,665; US-Patent-Appl-SN-385520) Avail: US Patent Office CSCL 14B

A temperature compensating arrangement for compensating for changes in the Hall voltage of a Hall generator with changes in the temperature of the generator, is described. The system consists of a control circuit including a constant voltage source connected to the control electrodes of the generator through a resistor. The resistor is the sole means for temperature compensation in the generator. Official Gazette of the U.S. Patent Office

N71-23039* Radio Corp. of America, New York.

THERMOCOUPLE ASSEMBLY Patent

Richard C. Turner, inventor (to NASA) Issued 9 Apr. 1968 (Filed 10 Nov. 1964) 4 p Cl. 136-230 Sponsored by NASA

(NASA-Case-XNP-01659; US-Patent-3,377,208; US-Patent-Appl-SN-410332) Avail: US Patent Office CSCL 14B

A thermocouple assembly which consists of a flexible strip of tape, similar to nylon, is described. One side of the tape has adhesive properties in order to support the junction of the thermocouple and permit attachment to the surface whose temperature is to be measured. The opposite side of the tape has a heat-reflecting metallic coating to minimize the heat which is directed to the junction through the tape. A pair of terminals, electrically insulated from each other, are provided to connect the thermocouple junction to appropriate circuitry.

Official Gazette of the U.S. Patent Office

N71-23040* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

SOLAR VANE ACTUATOR Patent

John C. Nicklas and James D. Acord, inventor (to NASA) Issued 5 Sep. 1967 (Filed 16 Sep. 1965) 7 p Cl. 244-1 Sponsored by NASA

(NASA-Case-XNP-05535; US-Patent-3,339,863; US-Patent-Appl-SN-487939) Avail: US Patent Office CSCL 14B

A solar vane actuator in an attitude control system for spacecraft is provided which includes sensory means responsive to heating by the sun's rays to distort a bimetallic element by which the actuator is rotated in small increments to produce a damping action about a stable attitude of the spacecraft with respect to radiation from the sun. Official Gazette of the U.S. Patent Office

N71-23041* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

TIME OF FLIGHT MASS SPECTROMETER WITH FEEDBACK MEANS FROM THE DETECTOR TO THE LOW SOURCE AND A SPECIFIC COUNTER Patent

Minoru Paul Nakada, inventor (to NASA) Issued 5 Sep. 1967 (Filed 22 Jun. 1964) 4 p Cl. 250-41.9 Sponsored by NASA

(NASA-Case-XNP-01056; US-Patent-3,340,395; US-Patent-Appl-SN-377146) Avail: US Patent Office CSCL 14B

A mass spectrometer which can measure or analyze gases

at low pressures is described. Other objectives of the mass spectrometer are: (1) measurement of time of flight of a single gas molecule, and (2) determination of the mass abundance of each component gas. These actions are accomplished by accelerating one electron at a time through the spectrometer. The ion gates an oscillator which is ungated at a predetermined time after the ion was created. The number of cycles of the oscillator between gating and ungating indicates the length of time of flight.
Official Gazette of the U.S. Patent Office

N71-23069 Karlsruhe Univ. (West Germany). Institut fuer Nachrichtenverarbeitung und Nachrichtenuebertragung.
THE KARLSRUHE SYSTEM FOR AUTOMATIC IMAGE PROCESSING
H. Kazmierczak and F. Holdermann *In* AGARD Principles and Pract. of Bionics 1968 p 293–308 refs (See N71-23053 11-05)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The task of photointerpretation for the purpose of object recognition consists in processing pictorial information and in automatically recognizing and localizing objects such as cultivated areas, housing and industrial areas, bridges, streets or cars in the streets. The research made in this field exclusively aims at basic explorations in the field of picture recognition. The described system for automatic photointerpretation is a scanning and preprocessing system under computer control. Commands concerning film transportation, scanning mode and screen resolution are sent from the computer to the special computing unit and to the scanner by channel one. The scanned and preprocessed information is transmitted by channel two into the computer, where it is stored and processed. Channels one and two are multiplexing channels of the computer Control Data 3300 with a high transmission rate.
Author

N71-23087* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
CONNECTOR INTERNAL FORCE GAUGE Patent
William W. Bond, inventor (to NASA) Issued 18 Jun. 1968 (Filed 29 Nov. 1965) 3 p Cl. 73-88.5 Sponsored by NASA
(NASA-Case-XNP-03918; US-Patent-3,388,590; US-Patent-Appl-SN-510475) Avail: US Patent Office CSCL 14B

A strain sensing transducer is attached to a connector pin positioned within a female connector receptacle. The strain produced in the pin by biasing means in the wall of the receptacle is sensed by the transducer and the resulting electrical signal produced is a measure of the quality of the electrical connection between the pin and the receptacle.
Official Gazette of the U.S. Patent Office

N71-23092* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
IMPACT ENERGY ABSORBER Patent
Ira S. Hoffman and Thomas Vranse, inventor (to NASA) Issued 22 Aug. 1967 (Filed 22 Dec. 1964) 5 p Cl. 188-1
(NASA-Case-XLA-01530; US-Patent-3,337,004; US-Patent-Appl-SN-420466) Avail: US Patent Office CSCL 14B

An impact energy absorber with a decreasing absorption rate is described for a visible color drag measuring system. The impact energy absorber includes a tape which gradually widens from the center towards the ends and is folded upon itself along the centerline. Starting with the narrow portion, the tape is wound on the shaft of a reel which unwinds when drag forces are applied. Energy is absorbed at a decreasing rate by the unrolling of the tape as well as the rotation of the reel.
Official Gazette of the U.S. Patent Office

N71-23093* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AUTOMATIC RECORDING MCLEOD GAUGE Patent
Paul A. Faeth, inventor (to NASA) Issued 23 Apr. 1968 (Filed 28 Dec. 1965) 5 p Cl. 73-400
(NASA-Case-XLE-03280; US-Patent-3,379,064; US-Patent-Appl-SN-517156) Avail: US Patent Office CSCL 14B

A McLeod gage is described having three electrodes disposed at various levels and a reservoir having an air bleed and connected to a vacuum source through a solenoid valve. The three electrodes are connected to a relay having a pair of contact sets and energized from an electrical power source. A current limiting resistor is joined serially with the relay winding. One contact set is connected to a relay in a power supply section to cause the solenoid valve to close when the contact set closes. A pair of resistance wires are disposed in the McLeod gage and joined to a recorder through a measuring circuit.
Official Gazette of the U.S. Patent Office

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N71-21993*# Rocketdyne, Canoga Park, Calif. Advanced Systems Dept.
DESIGN OF INDUCERS FOR TWO-PHASE OPERATION Final Report, 15 Jul. 1969 – 28 Jul. 1970
J. A. King Jul. 1970 99 p refs
(Contract NAS8-25069)
(NASA-CR-103054) Avail: NTIS CSCL 13K

The design, fabrication, and testing of an inducer in two-phase hydrogen is described. A mathematical model and a digital computer program were developed for the design and evaluation of inducers for pumping two-phase hydrogen. An inducer was designed according to the developed theory and tested on a Mark 15 axial-flow, liquid hydrogen pump. The two-phase hydrogen inducer accepted three times as much vapor as the Mark 15 inducer at 41 R.
Author

N71-21997*# Avco Corp., Lowell, Mass. Systems Div.
PULSE OPERATED FLOW PATH SELECTOR VALVE ASSEMBLY Final Test Report
R. Roulesu [1970] 303 p
(Contract NAS8-30075)
(NASA-CR-103086) Avail: NTIS CSCL 13K

Two pulse operated flow path selector valve assemblies were subjected to a comprehensive series of tests to qualify their use on a thermal control system. The test program demonstrated that the test items satisfy all of the requirements with exception of the Coil transient voltage requirement. However, when installed in an actual system, and operated with the control circuits, the performance of the valve does satisfy the specified coil transient voltage requirement. Noteworthy also is that the test items demonstrated significant performance margins beyond the minimum requirements of the procurement specification.
Author

N71-22137# Illinois Univ., Urbana. Coordinated Science Lab.
AN INTEGRATED NEAR-OPTIMUM DESIGN OF COLD ROLLING MILLS
Mohammad Jamshidi (Ph.D. Thesis) Jan. 1971 125 p refs Sponsored in part by Navy
(Contract DAAB07-67-C-0199; Grant AF-AFOSR-1579-68C)
(AD-717401; UILU-ENG-71-2202; R-499) Avail: NTIS CSCL 13/9

An Integrated Near-Optimum Design Method is introduced which makes a systematical use of the existing techniques which curbs many complexities involved in industrial systems. The method consists of a Subsystem decoupling stage which represents the originally high order model by a set of weakly coupled subsystems of much lower order. The second stage of the design is a Time-Scale decoupling in which the variables are divided into three slow, basic and fast categories according to the length of their response times. The slow and fast variables are eliminated and the near-optimum control is obtained by computations involving basic variables only. These two stages of decoupling are readily interchangeable depending on whether the model is linear or nonlinear. The method has been applied to an Allegheny Ludlum Steels high speed three-stand mill which can represent a 45-variable control system. Both linear and nonlinear dynamic and state space models are presented for the mill. In a digital computer simulation of the nonlinear model, two of the subsystems are studied in detail and an open loop near-optimum control as a power series of a decoupling parameter is obtained. The application of the method to the linear model resulted in an approximate solution of a 17th-order Riccati equation hence a state regulator feed-back gain matrix as a function of a plant parameter. Author (GRA)

N71-22198# National Research Council of Canada, Ottawa (Ontario).

QUARTERLY BULLETIN OF THE DIVISION OF MECHANICAL ENGINEERING AND THE NATIONAL AERONAUTICAL ESTABLISHMENT, 1 OCTOBER–31 DECEMBER 1970

31 Dec. 1970 84 p refs

(DME/NAE-1970/4/) Avail: NTIS

CONTENTS:

1. PRESENT STATUS OF ELECTRIC AUTOMOBILES J. J. Gottlieb p 1–38 refs (See N71-22199 11-15)

2. THE DEVELOPMENT AND TESTING OF A PYROTECHNIC SEEDING SYSTEM ON A MODIFIED T-33 G. K. Mather p 39–54 refs (See N71-22200 11-33)

N71-22199# National Research Council of Canada, Ottawa (Ontario). Low Temperature Lab.

PRESENT STATUS OF ELECTRIC AUTOMOBILES

J. J. Gottlieb *In its* Quart. Bull. of the Div. of Mech. Eng. and the Natl. Aeron. Estab., Oct.–Dec. 1970 31 Dec. 1970 p 1–38 refs (See N71-22198 11-15)

Avail: NTIS

The scope of the study includes developments in batteries, fuel cells and hybrid systems, controllers, chargers, electric motors, and body design features. Problems due to thermal conditioning and corrosion are also discussed. Author

N71-22257# Pisa Univ. (Italy). Istituto per l'Elaborazione Dell'Informazione.

ON THE STANDARDIZATION OF MOTION COMMANDS FOR THE APT LIKE LANGUAGES

S. Trumpy 21 Jul. 1970 71 p refs

(Contract F61052-67-C-0097)

(AD-717750; AFOSR-TR-71-0099; SR-4) Avail: NTIS CSCL 13/8

The report contains a description of several problems which have been discussed during the thecnical meetings of the ISO working group on Input languages comparison ISO/TC 97/ SC5 /WG1. This group has been formed to standardize the programming languages for N.C. machine tools and their description. In the present study an analysis has been first made of the standardization problem and of methodology followed by the ISO group; secondly some problems arising when dealing with the motion commands, are presented. The proposed document on Geometrical execution statements, submitted by Mr. S. Trumpy to the last meeting of the I.S.O. working group (PISA 24 -25 giugno 1970), is attached. Author (GRA)

N71-22258# Pisa Univ. (Italy). Istituto per l'Elaborazione dell'Informazione.

AN ALGORITHMIC DESCRIPTION OF CUT VECTOR IN COMPUTATION. THE APT SYSTEM

G. Galbiati and S. Trumpy 21 Jul. 1970 121 p refs

(Contract F61052-67-C-0097)

(AD-717777; AFOSR-TR-71-0100; B70-18; SR-3) Avail: NTIS CSCL 13/8

In the computer-aided determination of a three-dimensional path for numerical control machine tools, the APT-III approach is described algorithmically, as a contribution to a much needed formalization, both for theoretical and practical purposes. The fundamental case of only one check-surface with one single intersection is considered. More than thirty routines are described in a language patterned after ALGOL 68. Author (GRA)

N71-22293# Pisa Univ. (Italy). Istituto per l'Elaborazione Dell'Informazione.

LANGUAGES FOR AUTOMATIC PROGRAMMING TOOLS Final Scientific Report

Alfonso Caracciolo di Forino, Antonio Camera, and Stefano Trumpy 10 Nov. 1970 74 p refs

(Contract F61052-67-C-0097)

(AD-717778; IEI-RR-B70-23; AFOSR-71-0101TR) Avail: NTIS CSCL 13/8

The report represents the final scientific report of the research work performed under the Air Force contract concerning languages for automatic programming tools. It contains a summary of the results attained in the area of the formal definition of machine tools and their languages including an analysis of motion commands in APT and contributions to the ISO standardization work. Furthermore it contains a description of the most recent results concerning the definition and usage of high level languages for surfaces clearing and the automatic determination of tool paths for threedimensional dies. Author (GRA)

N71-22373# Pisa Univ. (Italy). Istituto per l'Elaborazione Dell' Informazione.

AN ANALYSIS OF HOW MOTION COMMANDS ARE PROCESSED IN THE APT SYSTEM

S. Trumpy 21 Jul. 1970 33 p refs

(Contract F61052-67-C-0097)

(AD-717749; AFOSR-TR-71-0103; SR-2) Avail: NTIS CSCL 13/8

The report contains a description of how motion commands are processed in the APT System. The present work is part of an analysis of machine tool languages, which is being carried out in order to obtain a clear understanding of the theoretical and practical problems which underly their definition and usage. Making reference to the geometrical execution statements as they appear in the part program, various processors of the APT System have been examined in order to analyse the preliminary elaborations performed on the source statements, up to the point at which the ARELEM section is called for the final computation of the three dimensional tool path. Author (GRA)

N71-22398# Stanford Univ., Calif Dept. of Mechanical Engineering.

THE INFLUENCE OF BRAZING ON VERY COMPACT HEAT EXCHANGER SURFACES

Ramesh K. Shah and A. L. London Nov. 1970 65 p refs

(Contract Nonr-225(91))

(AD-717661; SU-TR-73) Avail: NTIS CSCL 13/1

Three geometrically similar offset rectangular plate-fin surfaces with area densities in the range from 900 to 2000 sq ft/cu ft were tested to establish the heat transfer, j-NR, and flow friction, f-N sub R, characteristics. The Reynolds number range was from 60 to 3000. One surface was unbrazed while the other two, because of a two-to-one difference in plate, fin and offset spacing dimensions, were characterized by different degrees of brazing roughness. The test results reveal a relatively small effect of brazing on j-N sub R, but a significant influence on f-N sub R, with a 35 to 50 percent higher friction for the brazed surface. There is an area penalty of 14 percent due to brazing associated with the complete coverage of the interface area at the brazed joints. The magnitude of this penalty depends on the geometry of the surface. Author (GRA)

N71-22401*# Arde, Inc., Mahwah, N.J.
DEVELOPMENT OF A FILAMENT-OVERWRAPPED CRYOFORMED METAL PRESSURE VESSEL Final Report, Jul. 1967 – Aug. 1970
D. Gleich Jan. 1971 154 p refs
(Contract NAS3-11194)
(NASA-CR-72753; ARDE-41001) Avail: NTIS CSCL 13D

High performance Ardeform cryoformed 301 stainless steel glass fiber reinforced (GFR) vessels were demonstrated by room temperature tests of 13-1/2 in. diameter spheres. Tests verified that the performance of Ardeform spherical GFR vessels not only exceeded that of all metal construction, but also bettered previous GFR experimental results by 50%. Further improved Ardeform GFR configurations were identified. Achievement of full strength of fiberglass in a spherical wrap pattern was again verified by tests. A low GFR vessel fabrication scrap factor of 13% was demonstrated. Author

N71-22493# Bendix Corp., Kansas City, Mo.
DESIGN OF AN INSULATOR WHICH MUST SURVIVE HIGH g FORCES
V. J. Guzzo and L. F. Thorne Jun. 1970 39 p Sponsored by AEC
(BDX-613-213) Avail: NTIS

An insulator which mechanically closes a set of contacts as an end-function of a timing mechanism has proven, at times, unable to survive the high g-forces imparted by an explosive piston motor. A test program to evaluate refinements in the design of the insulator was completed. It was found that changing the insulator material from nylon to polycarbonate and increasing the size of the mounting pin produced an insulator several magnitudes stronger than the original. Author

N71-22527*# Battelle Memorial Inst., Columbus, Ohio.
ANALYSIS OF BRINELLING FAILURE OF BEARINGS FROM VIBRATION TESTED PLV FANS Summary Report
W. A. Glaeser, S. K. Batra, and R. H. Prause 8 Jun. 1970 51 p Sponsored by NASA
(NASA-CR-117855) Avail: NTIS CSCL 13I

Brinelling damage was identified in PLV fan bearings as the cause for noisy running after exposure to a random-vibration environment. Assuming a maximum Hertz stress of 460,000 psi to produce brinelling, the maximum axial load for the fan bearing was calculated as 43 pounds. Dynamic analysis of the rotor-bearing-spring system revealed that with one preload spring, the maximum predicted axial load would be 297 pounds. It was determined that reduction in maximum bearing loads under vibration conditions could be achieved by reducing the rotor natural frequency and by increasing the damping through using a soft spring system. When a system of five springs at each end of the rotor was considered, the bearing load predicted was 58 pounds. Actual vibration tests using the 5-spring preload configuration resulted in reduction of bearing damage. A bearing load-capacity computer program was written so that, given the bearing parameters, inner race diameter, ball diameter, diametral clearance, total curvature of the race groove and number of balls, the limiting axial load can be determined using maximum Hertz stress. Author

N71-22530# Sandia Corp., Albuquerque, N.Mex.
OUTDOOR AGING OF ADHESIVE SEALANTS
Nicholas J. De Lollis and Orelio Montoya Apr. 1970 25 p refs
(SC-RR-70-163) Avail: NTIS

The results of five-year aging tests on five different types of polysulfide and silicone adhesive sealants under various environments, including semi-arid and marine type outdoor aging sites are given. These are compared to oven aging and ambient shelf aging results. Data on continuous exposure for twelve months to high humidity with cycling temperature are also included. The results indicate that a marine climate is the worst exposure condition. The results also show that a manganese peroxide cured polysulfide is more sensitive to a marine climate than is a lead peroxide cured polysulfide. Author

N71-22531# Dow Chemical Co., Golden, Colo. Rocky Flats Div.
VAPOR ION METHODS OF FILM DEPOSITION SUMMARY AND ANNOTATED BIBLIOGRAPHY
Robert G. Kurtz 18 Dec. 1970 12 p
(Contract AT(29-1)-1106)
(RFP-1568) Avail: NTIS

Background data are summarized on the vapor-ion methods of film deposition for the purpose of developing new applications and for determining the emphasis in future projects. Briefly described are the advantages over chemical-vapor techniques. Related work experiments of early studies are discussed, as well as current trends. In addition, an annotated bibliography is included. Author

N71-22532# Bendix Corp., Kansas City, Mo.
SPLIT FIBERGLASS HOLDER
H. F. Darbyshire Aug. 1970 17 p
(Contract AT(29-1)-613)
(BDX-613-198) Avail: NTIS

Fabrication techniques were developed and six fiberglass holder assemblies (Holder, Split Fiberglass K65006) were manufactured. One test part and several material specimens were made and test results are given. Author

N71-22541# Cranfield Inst. of Technology (England).
EFFECT OF WELDING AND POST-WELD HEAT TREATMENT ON QT 35 STEEL
E. Smith and R. L. Apps May 1970 37 p refs
(Rept-2) Avail: NTIS

A simulation technique was employed to examine the structures and properties of the heat affected zone in single and multipass submerged arc welds in QT 35 steel for a range of heat inputs i.e. 1.2, 2.1, and 4.2 kJ/mm. Mechanical properties were assessed using Charpy V-notch, tensile and hardness tests and related to microstructure as determined by electron microscopy. Notch impact values deteriorated over the range of thermal cycles examined and were most severely affected by high peak temperatures and by slow cooling rates which gave the coarsest metallurgical structures. Additional thermal cycles corresponding to those applied by tempering weld beads were shown to improve impact performance in some parts of the heat affected zone, but not in others. The effects of post-weld heat treatments at 450 C, 550 C, 650 C and 700 C for 1 hour on the coarse grained heat affected zone structures were examined. Further embrittlement occurred after treatment at 450 C but the notch toughness improved at higher temperatures. Treatment at 650 C was the most

effective and reliable method of improving notch toughness without adversely affecting the parent plate strength. The significance of the results in relation to service behavior is discussed. Author

N71-22705# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CONFORMING POLISHER FOR ASPHERIC SURFACE OF REVOLUTION Patent
William J. Hungerford, John W. Larmer, and Maurice Levinsohn, inventors (to NASA) Issued 19 Sep. 1967 (Filed 12 Feb. 1965) 5 p Cl. 51-57
(NASA-Case-XGS-02884; US-Patent-3,341,977; US-Patent-Appl-SN-432433) Avail: US Patent Office CSCL 13H

A conforming polisher for an aspheric surface of revolution is described, including an inflatable tube for applying polish with a uniform pressure. Official Gazette of the U.S. Patent Office

N71-22706* North American Aviation, Inc., El Segundo, Calif.
POSITIVE LOCKING CHECK VALVE Patent
Norbert E. Cahill, inventor (to NASA) Issued 21 May 1968 (Filed 20 Jul. 1967) 3 p Cl. 137-496 Sponsored by NASA
(NASA-Case-XMS-09310; US-Patent-3,384,111; US-Patent-Appl-SN-655724) Avail: US Patent Office CSCL 13K

A check valve assembly is described capable of opening to allow flow in one direction and of closing and locking to prevent flow in the opposite direction. The valve assembly has a ball detent latch which locks the valve in a closed position and is held by a compression spring force of a bellows. With bellows expansion, the valve is unlatched and opened for flow; reverse flow will reset the valve, collapse the bellows, and actuate the latch to lock the assembly in a closed position.
Official Gazette of the U.S. Patent Office

N71-22712 Pennsylvania Univ., Philadelphia.
THE DYNAMIC RESPONSE OF AXIALLY COUPLED TURBOROTORS
Donald George Lemke (Ph.D. Thesis) 1969 124 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 70-7821

An analytical investigation of the effect of coupling characteristics on the response of axially coupled sets of turborotors is presented. A digital computer program based on transfer matrix techniques and utilizing a coupling fixity matrix was developed. Gyroscopic effects and both shaft as well as coupling orthotropy were included in the program. Linear bearings were assumed and the motion was restricted to synchronous precession. An illustrative example, utilizing two axially coupled modified Prohl rotors, demonstrates that the nature of the coupling has a significant effect on the response characteristics of the rotor set. The coupling must be considered when writing balancing specifications and during actual balancing of the rotor set. It is shown that the axial coupling of turborotors can result in the unloading of particular bearings which may initiate journal instabilities that are known to be associated with light loading conditions. Dissert. Abstr.

N71-22713* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
METHOD OF MAKING INFLATABLE HONEYCOMB Patent
Emanuel Schnittzer, inventor (to NASA) Issued 19 Sep. 1967 (Filed 6 Aug. 1964) 6 p Cl. 156-60 Continuation-in-part of US Patent Appl. SN-189648, filed 23 Apr. 1962
(NASA-Case-XLA-03492; US-Patent-3,342,653; US-Patent-Appl-SN-395348) Avail: US Patent Office CSCL 13H

A method of making a foldable inflatable panel in which a first skin is positioned on a work area and coated with an adhesive; a vertically disposed peripheral wall is secured about the periphery of the first skin; a plurality of interconnecting vertically disposed honeycomb cells are secured to the first skin and within the peripheral wall; a second skin having an adhesive coating is secured in fluid tight relationship with the honeycomb cells and the peripheral wall; and the resulting structure is folded, end to end, into a compact package. Official Gazette of the U.S. Patent Office

N71-22721* Douglas Aircraft Co., Inc., Santa Monica, Calif.
PORTABLE SUPERCLEAN AIR COLUMN DEVICE Patent
Walter Kiszko, inventor (to NASA) Issued 28 May 1968 (Filed 6 Sep. 1966) 7 p Cl. 55-418 Sponsored by NASA
(NASA-Case-XMF-03212; US-Patent-3,385,036; US-Patent-Appl-SN-577549) Avail: US Patent Office CSCL 13I

A portable apparatus for producing a high velocity annular air column surrounding a central core of low velocity, filtered superclean air is described to provide an atmosphere equivalent to that of a clean room at any desired work location. A plurality of adjustable louvers in an annular cavity of a projecting hood proportionally controls the volume of air delivered to the projecting hood central filter core and the annular passage. A second set of adjustable louvers controls the exhaust aperture size of the annular passage which governs the thickness and velocity of the annular air column. Official Gazette of the U.S. Patent Office

N71-22722* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
APPARATUS FOR MACHINING GEOMETRIC CONES Patent
John H. Allen, Sr. and Orrin A Wobig, inventors (to NASA) Issued 19 Mar. 1968 (Filed 28 Dec. 1965) 5 p Cl. 82-14
(NASA-Case-XMS-04292; US-Patent-3,373,640; US-Patent-Appl-SN-517157) Avail: US Patent Office CSCL 13I

A method is outlined for machining geometrical cones on a machine lathe with high surface accuracy. The pattern cam, cam follower, tracer bar guide, tracing stylus, cutting tool, and lathe tracer attachments are described for use with rotary spindle lathes. J.M.

N71-22723* Chance Vought Corp., Dallas, Tex.
SPIN FORMING TUBULAR ELBOWS Patent
Donald C. Fish, inventor (to NASA) Issued 12 Sep. 1967 (Filed 11 Feb. 1965) 4 p 72-83 Sponsored by NASA
(NASA-Case-XMF-01083; US-Patent-3,340,713; US-Patent-Appl-SN-432028) Avail: US Patent Office CSCL 13H

An apparatus and method for spin forming a tubular elbow about a curved cylindrical mandrel is described by rotating the mandrel with the blank material in a specific manner so that a roller thins the blank material along the mandrel.
Official Gazette of the U.S. Patent Office

N71-22724 Purdue Univ., Lafeyette, Ind.
DYNAMIC STABILITY OF ROTATING SYSTEMS
Joel Sweet (Ph.D. Thesis) 1969 137 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 70-8978

The dynamic system considered is a rotating shaft with a rotor positioned at its midpoint. The differential equations describing this continuous sytem are reduced to a discreet form using Galerkin's method of analysis. Expressions for the stiffness of the shaft and the equivalent mass of the system are derived. The rotating system is mounted on full journal bearings with an incompressible fluid providing the lubrication. Additional contributions to these forces are derived and are of the same order of magnitude as the shear stress contribution. The nonlinear oil whip equations are analyzed using a variation of the classical slowly varying parameter method of solution. It is demonstrated that the resulting nonlinear solution exhibits all of the experimental characteristics of the oil whip phenomenon. The slowly varying method is then applied to the analysis of other system configurations. A mathematical model of the squeeze film bearing is developed and included in the rotating system. Dissert. Abstr.

N71-22797* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PROTECTIVE DEVICE FOR MACHINE AND METALWORKING TOOLS Patent

Charles P. Blankenship and Charles A. Gyorgak, inventors (to NASA) Issued 19 Sep. 1967 (Filed 29 Dec. 1964) 4 p Cl. 72-253

(NASA-Case-XLE-01092; US-Patent-3,342,055; US-Patent-Appl-SN-422098) Avail: US Patent Office CSCL 13I

A protective device for permitting the working of metal products in an inert gas atmosphere is described. The device consists of an elongated pressure chamber which covers the metal being worked on. The pressure chamber is filled with an inert gas which prevents excessive oxidation of the metal during the metal working process. Official Gazette of the U.S. Patent Office

N71-22798* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

ALIGNING AND POSITIONING DEVICE Patent

Alphonse M. Thiel, inventor (to NASA) Issued 6 Feb. 1968 (Filed 1 Dec. 1965) 4 p Cl. 83-467

(NASA-Case-XMS-04178; US-Patent-3,367,224; US-Patent-Appl-SN-511299) Avail: US Patent Office CSCL 13I

A device for aligning and positioning material which is to be cut at an angle to the reference plane of the machine is described. The device consists of a cutting guide for use in aligning stacks of paper sheets and for positioning the sheets beneath the cutter blade at consistently identical angles, regardless of the number of stacks to be cut.

Official Gazette of the U.S. Patent Office

N71-22799* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

PORTABLE MILLING TOOL Patent

Raymond A. Spier, inventor (to NASA) Issued 4 Jun. 1968 (Filed 5 Apr. 1966) 5 p Cl. 90-12

(NASA-Case-XMF-03511; US-Patent-3,386,337; US-Patent-Appl-SN-540414) Avail: US Patent Office CSCL 13I

A portable milling machine for milling tube or pipe ends to a desired shape and thickness is described. The device consists of an expandable mandrel which fits within the end of a tube and presses against the inside surface to round the end. The tool has a router revolving about the center of the mandrel to mill the end edge of the tube. Official Gazette of the U.S. Patent Office

N71-22800 North Carolina State Univ., Raleigh.

POST SEPARATION BEHAVIOR OF MECHANICAL SYSTEMS SUBJECTED TO HARMONIC EXCITATIONS

Herbert Hewett Hill (Ph.D. Thesis) 1969 118 p

Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 70-9187

Results are reported of a theoretical study of the kinematic and dynamic response of elastically supported mechanical systems having some interface which is subject to mechanical separation. Specifically, two mechanical systems were investigated; (1) a simple cam follower, and (2) a rotary face seal. For each of these systems the character and magnitude of post-separation behavior was studied as a function of the significant system and operating condition parameters. Each of the mechanical systems were approximated by lump system parameters (masses, inertias, springs, and dashpots) which permit simulation of their dynamic response when subjected to external excitation. The excitations were in all cases assumed to be some combination of harmonic pulsations. Interface elasticity was included in both models by including contact springs for transmitting the contact forces. Dissert. Abstr.

N71-22884# Israel Program for Scientific Translations, Ltd., Jerusalem.

ON THE INFLUENCE OF THE PRINCIPAL DIMENSIONS OF AN ICEBREAKER HULL ON ICE RESISTANCE

V. K. Eliseev *In its* Probl. of the Arctic and the Antarctic 1970 p 496–500 ref (See N71-22801 11-13)

Copyright. Avail: NTIS HC $6.00/MF $0.95

Some theoretical considerations are presented with regard to the influence of the length and width of an icebreaker hull on ice resistance when moving in compact ice at low speed. Values used in the investigation were: ice thickness range of 0.5 to 2.0 m; ship speed of 2 knots; and ice bending strength of 8 kg/sq cm. The influence of the vessel immersion on the ice resistance was not taken into consideration as it was considered negligible. Total ice resistance was determined by considering the following separate components: (1) resistance due to breaking of the ice by the bow and the associated friction resistance; (2) resistance resulting from towing and overturning of broken ice; (3) resistance of the water to separation of broken ice, and resistance due to interaction of individual ice blocks with one another; (4) resistance due to energy losses upon separation of the ice by the hull; and (5) resistance of water to ship movement. A.L.

N71-22866# Israel Program for Scientific Translations, Ltd., Jerusalem.

A NEW ANNULAR ICE AUGER

N. V. Cherepanov *In its* Probl. of the Arctic and the Antarctic 1970 p 506–510 (See N71-22801 11-13)

Copyright. Avail: NTIS HC $6.00/MF $0.95

This auger is designed for manual drilling of various diameter holes to yield core samples. It differs from other types in not having the metal cylinder and transport screw which are major components of most corers. The corer is a hollow steel cylinder 100-110 cm long, carrying on its outside a conveyor screw for the transport of shavings. The cutting arrangement of corers consists of several blades. The manufacture of the corers is complicated, and even those of the least weight produce cores 7-8 cm in diameter and weighing 20 kg or more. A.L.

N71-22870*# Perkin-Elmer Corp., Pomona, Calif. Aerospace Div.

COMBINED STUDY PROGRAM. VOLUME 2: ION PUMP Final Report

N. Ierkomos Mar. 1971 69 p refs

(Contract NAS1-9469)

(NASA-CR-111856; SPO-30006-Vol-2) Avail: NTIS CSCL 13K

A flight configuration ion pump and magnet assembly was developed for use in flight mass spectrometers. The required pumping speed of about four liters per second was achieved in the final configuration. An analysis is given of rough pumping techniques that may be utilized to pump down a flight mass spectrometer system from some high pressure (including one atmosphere) to a pressure at which the ion pump may be started. In the rough pumping investigation, several methods were analyzed. These methods included: sublimation pumping, use of a line to outer space and cryo-sorption pumping. A line to outer space or cryo-sorption pumps with thermoelectric devices or a combination of sorption and sublimation pumping are the only space usable devices that are adequate. Author

N71-22871*# Perkin-Elmer Corp., Pomona, Calif. Aerospace Div.

COMBINED STUDY PROGRAM. VOLUME 3: ION PUMP POWER SUPPLY Final Report

Michael F. Hagen Mar. 1971 57 p

(Contract NAS1-9469)

(NASA-CR-111857; SPO-30006-Vol-3) Avail: NTIS CSCL 13K

The high voltage ion pump power supply was designed to operate a four liter per second ion pump efficiently and reliably. The ion pump power supply has demonstrated compliance to the specification requirements for a minimum power (under 30 watts) breadboard power supply capable of reliably starting the ion pump

at pressures of 0.001 torr. Breadboard testing has shown that the maximum measured input power to the ion pump power supply is approximately twenty watts, which met and exceeded the design goal of thirty watts maximum. Additional testing with a test load simulating a four liter per second ion pump at a pressure of 0.001 torr demonstrated the ability of the power supply to provide sufficient output power capability to reliably start the pump. An added feature of the power supply is its ability to withstand momentary short circuits on its output without damage. Author

N71-22874* Chance Vought Corp., Dallas, Tex.
SINGLE ACTION SEPARATION MECHANISM Patent
Whitney McCormack and Arthur W. Sotherlund, Jr., inventor (to NASA) Issued 13 Feb. 1968 (Filed 29 Jan. 1963) 5 p Cl. 102-49.5 Sponsored by NASA
(NASA-Case-XLA-00188; US-Patent-3,368,486;
US-Patent-Appl-SN-254847) Avail: US Patent Office CSCL 13I

A separation mechanism is described that provides immediate and even separation of the stages for multistage space vehicles. A frangible plate is used to join the stages, and is positioned so that the exhaust blast of the next stage ruptures the plate allowing the separation of the upper and lower stages. F.O.S.

N71-22877* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ENERGY ABSORBING DEVICE Patent
Georg F. von Tiesenhausen, inventor (to NASA) Issued 7 May 1968 (Filed 4 Nov. 1966) 5 p Cl. 188-1
(NASA-Case-XMF-10040; US-Patent-3,381,778;
US-Patent-Appl-SN-592680) Avail: US Patent Office CSCL 22B

A nonreuseable energy absorbing device is described having a ring member with a plurality of recesses formed therein, cutting members, and a guide member mounted in each recess. A sleeve is slidably mounted on each guide member such that the sleeve can be cut into strips and the strips deformed so as to absorb energy. Each sleeve has longitudinal calibration grooves formed therein that are in alignment with a cutting member so that groove depth influences the cutting force required. A second ring member has one end of each sleeve attached thereto.
Official Gazette of the U.S. Patent Office

N71-22878* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
TENSION MEASUREMENT DEVICE Patent
Thomas M. Grubbs, inventor (to NASA) Issued 7 May 1968 (Filed 18 Nov. 1965) 5 p Cl. 73-144
(NASA-Case-XMS-04545; US-Patent-3,381,527;
US-Patent-Appl-SN-508601) Avail US Patent Office CSCL 14B

An apparatus for measuring a load on a cable under either static or dynamic conditions is described. It comprises a pivotally mounted, dual pulley, line bearing structure restrained against movement by an electrical tension strap. The load on a cable passing over the pulleys attempts to pivot the structure against the restraint of the tension strap. Strain gauges on the strap provide a rear-out of the load on the cable. This measuring device may be altered in size, shape, materials, and the relative location of the pulleys to each other. Drawings are accompanied by specifications of the device. Official Gazette of the U.S. Patent Office

N71-22982* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SEMI-LINEAR BALL BEARING Patent
William W. Anderson, Jr., inventor (to NASA) Issued 20 Aug. 1968 (Filed 2 Jun. 1966) 3 p Cl. 308-176
(NASA-Case-XLA-02809; US-Patent-3,397,932;
US-Patent-Appl-SN-554897) Avail: US Patent Office CSCL 13I

A semilinear bearing is described having two rows of roller bearings separated by spherical bearings. The bearings are all mounted in inner and outer races in order to permit rotational and translational movement between members connected to inner and outer races thereof. Drawings of the device are referenced.
Official Gazette of the U.S. Patent Office

N71-22994* National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
QUICK ATTACH MECHANISM Patent
Andrew E. Vano, inventor (to NASA) Issued 23 Apr. 1968 (Filed 25 Jul. 1966) 5 p Cl. 24-126
(NASA-Case-XFR-05421; US-Patent-3,378,892;
US-Patent-Appl-SN-567686) Avail: US Patent Office CSCL 13E

A clamp device, with slideable jaws, is described. The clamp is used to attach both stationary and moving objects as ropes, wires, or cables. The major functions of the clamp include: (1) providing a means for quick application without the jaws getting in the way, and (2) providing a means by which the clamp can be held in a readiness condition so it can be applied whenever desired. E.H.W.

N71-22997* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
HYBRID LUBRICATION SYSTEM AND BEARING Patent
Leonard S. Sauer, inventor (to NASA) Issued 16 Apr. 1968 (Filed 17 Jun. 1965) 5 p Cl. 308-10 Sponsored by NASA
(NASA-Case-XNP-01641; US-Patent-3,378,315;
US-Patent-Appl-SN-464885) Avail: US Patent Office CSCL 13G

A method for lubricating journal bearings which will permit operation in earth atmosphere and space environment is presented. The system for earth atmosphere operation consists of a standard lubrication technique. The system for space environment operation depends on a magnetic field to replace the standard lubrication type system. Official Gazette of the U.S. Patent Office

N71-23022* Pratt and Whitney Aircraft, East Hartford, Conn.
SEALING MEMBER AND COMBINATION THEREOF AND METHOD OF PRODUCING SAID SEALING MEMBER Patent
Thomas E. O'Rourke, Jr., inventor (to NASA) Issued 18 Jun. 1968 (Filed 16 Dec. 1964) 6 p Cl. 136-86 Sponsored by NASA
(NASA-Case-XMS-01625; US-Patent-3,389,017;
US-Patent-Appl-SN-418933) Avail: US Patent Office CSCL 11A

A method for producing a sealing member for sealing between the electrodes of a fuel cell containing a caustic liquid electrolyte is described. The sealing member includes a central portion of corrosion resistant powered plastic material and reinforcement portions on both sides of the central portion which comprise alternate layers of powdered metal and powdered plastic in which the plastic is of decreasing concentration in inverse proportion to distance from the electrically insulative central portion. The outer layer is metal to permit welding to an electrode. Construction is accomplished by laying down the successive layers of powdered metal and powdered plastic in a mold and sintering under elevated temperature and pressure.
Official Gazette of the U.S. Patent Office

N71-23023* Brown Engineering Co., Inc., Huntsville, Ala.
VAPOR LIQUID SEPARATOR Patent
Wyley D. Ward, inventor (to NASA) Issued 20 Aug. 1968 (Filed 28 Dec. 1966) 3 p Cl. 55-204 Sponsored by NASA
(NASA-Case-XMF-04042; US-Patent-3,397,512;
US-Patent-Appl-SN-605518) Avail: US Patent Office CSCL 13K

A device for separating vapor from liquid of a heterogeneous vapor-liquid mixture ranging from 100% liquid to 100% vapor in a zero gravity environment is described. The separated vapor drives a pump that forces the separated liquid to the desired location thus avoiding the need for an additional power source to drive the pump. The heterogeneous fluid is expanded and swirled in a separation chamber. A vapor exhaust conduit receives the vapor at

the central region of the swirl pattern while the liquid at the outer region of the swirl pattern is collected in a liquid collection manifold and pumped to the desired location.
Official Gazette of the U.S. Patent Office

N71-23024* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
FILLER VALVE Patent
William F. Mac Gleshan, Jr., inventor (to NASA) Issued 12 Sep. 1967 (Filed 24 Nov. 1964) 4 p Cl. 251-148 Sponsored by NASA
(NASA-Case-XNP-01747, US-Patent-3,341,169;
US-Patent-Appl-SN-413661) Avail: US Patent Office CSCL 13K

A filler valve is described consisting of a vehicle component, which is permanently attached to a vehicle. The component defines a flow passage through which fuel or the like is supplied to the vehicle. A valve carrier threadably coupled to the vehicle component is used to close or open the flow passage for communication with a supply passage, defined in a supply line component. The latter component is selectively coupled to the vehicle component. After being temporarily secured in place, the valve carrier is operated through the supply line component to open the flow passage for fuel supply. The supply is terminated by closing the flow passage with the valve carrier and disengaging the supply line component from the vehicle component.
Official Gazette of the U.S. Patent Office

N71-23028* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
REFRIGERATION APPARATUS Patent
Walter H. Higa, inventor (to NASA) Issued 6 Feb. 1968 (Filed 19 Aug. 1966) 6 p Cl. 62-6 Sponsored by NASA
(NASA-Case-XNP-08877; US-Patent-3,367,121;
US-Patent-Appl-SN-574282) Avail: US Patent Office CSCL 13I

A self-starting refrigeration apparatus is described which is capable of producing temperatures below −100 C by gas balancing. A motor driven valve is employed to steer high and low pressure gas to drive a displacer for effecting the desired gas compression and expansion for refrigeration. Schematics of the apparatus are included. J.M.

N71-23048* Space Technology Labs., Inc., Redondo Beach, Calif.
FLUID LUBRICANT SYSTEM Patent
Joseph C. Heindl and Robert J. Belanger, inventors (to NASA) Issued 6 Feb. 1968 (Filed 22 Oct. 1965) 4 p Cl. 184-1 Sponsored by NASA
(NASA-Case-XNP-03972; US-Patent-3,367,445;
US-Patent-Appl-SN-502710) Avail: US Patent Office CSCL 11H

An apparatus is described for providing lubrication for moving mechanism such as gears or bearings, which are required to operate under very adverse conditions. This is achieved by placing a porous material constituting an oil reservoir in proximity with the face of a bearing or gear so that capillary attraction fills the space. Centrifugal forces distribute the oil from the space between the reservoir and the bearing or gear to the surfaces requiring lubrication.
Official Gazette of the U.S. Patent Office

N71-23049* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
CONTINUOUS TURNING SLIP RING ASSEMBLY Patent
Estel G. Lowe, inventor (to NASA) Issued 26 Mar. 1968 (Filed 2 Nov. 1965) 7 p Cl. 339-5
(NASA-Case-XMF-01049; US-Patent-3,375,479;
US-Patent-Appl-SN-506137) Avail: US Patent Office CSCL 13I

A slip ring assembly having inner and outer peripheral surfaces which serve as electrical contacts for brushes is described. One set of brushes is located between a centrally normally stationary part and the slip rings so that the brushes engage the inner surface of the slip rings. The other set of brushes is located between an oscillating part and the slip rings so that the brushes engage the outer surface of the latter.
Official Gazette of the U.S. Patent Office

N71-23050* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
AUTOMATIC WELDING SPEED CONTROLLER Patent
William A. Wall, Jr., inventor (to NASA) Issued 19 Mar. 1968 (Filed 30 Dec. 1965) 6 p Cl. 228-8
(NASA-Case-XMF-01730; US-Patent-3,373,914;
US-Patent-Appl-SN-517869) Avail: US Patent Office CSCL 13H

A welding torch with an automatic speed controller is described which uses a carriage with a speed sensing wheel, and a wheel operated synchro controlled transmitter which is connected to a transformer geared to a drive motor. The work speed is transferred into the synchro shaft speed, and a difference amplifier in circuit with the transformer and drive motor receives error signals from the synchro transmitter through the synchro transformer and transmits them to the drive motor causing the drive motor to rotate in the direction for reducing the error. F.O.S.

N71-23061* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TRANSFER VALVE Patent
Albert A. Puccinelli and Joseph R. Smith, Jr., inventors (to NASA) Issued 20 Feb. 1968 (Filed 16 Dec. 1964) 3 p Cl. 137-625.5
(NASA-Case-XAC-01158; US-Patent-3,369,564;
US-Patent-Appl-SN-420250) Avail: US Patent Office CSCL 13K

A three-port transfer valve is described having one continuously open main port with the fluid flow to the main port being selectively transferable from one to the other of the remaining two ports which are positioned in opposed coaxial relationship. A hollow valve member, guided for linear movement between these two opposed valves, has a cam surface formed on the inside wall. A cam driver is rotatably supported in engagement with the cam surface so that when the cam driver is rotated it will force the valve member toward either of the two opposed ports, thereby closing one and opening the other. When in this position, the valve member is locked by the cam driver against movement in response to fluid pressure in the closed port. The cam driver is driven by remote control, with little or no power being required to hold the valve member in the locked position, even when subjected to substantial acceleration forces.
Official Gazette of the U.S. Patent Office

N71-23062* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
METHOD OF MAKING AN INFLATABLE PANEL Patent
Warren Gillespie, Jr., inventor (to NASA) Issued 12 Mar. 1968 (Filed 10 Aug. 1964) 14 p Cl. 156-285 Continuation-in-part of US Patent Appl. SN-82658, filed 13 Jan. 1961
(NASA-Case-XLA-03497; US-Patent-3,373,069;
US-Patent-Appl-SN-392992) Avail: US Patent Office CSCL 13H

A method is described for forming inflatable panels for passive communication satellites as erectable radio signal reflectors in space. Two sheets of waffle-like cross section are pressed together, and the edges are bonded. A subliminatory material is inserted between the sheets forming the inflatable panel. F.O.S.

N71-23068* Melpar, Inc., Falls Church, Va.
COMPACT SOLAR STILL Patent
Robert W. Smith, Louis P. Glekas, John F. Riley, and Robert L. Swingle, inventors (to NASA) Issued 13 Aug. 1968 (Filed 13 Jun. 1966) 5 p Cl. 202-234 Sponsored by NASA
(NASA-Case-XMS-04533; US-Patent-3,397,117;
US-Patent-Appl-SN-557016) Avail: US Patent Office CSCL 13I

A solar still for converting saline or brackish water to potable water is described. The apparatus has an inflatable frame which includes an inflatable mattress base with integral inflatable ribs extending in pyramidal configuration from the corners of the mattress to a common junction above approximately the center of the mattress. A solar radiation transparent envelope is disposed about, and when the frame is in its inflated condition, is supported by the frame. The envelope provides, at the underside of the mattress, a lower collection basin for the condensate which forms on the inner surface of the envelope as solar radiation penetrating the transparent walls of the envelope heats a black radiation absorbing evaporator layer to which the water to be distilled is fed from a pouch or bag in a wall of the envelope.
Official Gazette of the U.S. Patent Office

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N71-21857 Ohio State Univ., Columbus.
LINEAR AND NONLINEAR SPECTRAL ANALYSIS OF THE DYNAMICS OF A Q-SWITCHED LASER PULSE
Joe Thomas Boyd (Ph.D. Thesis) 1969 119 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 70-6730

Variations of the spectral bandwidth of the pulse for different experimental situations are the primary concern. The analysis is based on a quantum mechanical model of the laser. A system of equations specifying the spectral distribution of pulse energy is derived from the equation of motion of the density matrix corresponding to the laser model. Extensive numerical solutions of these equations for the linear case are presented. Parameters typical of a ruby laser operating at room temperature are employed in the calculations. The spectral bandwidth of the pulse is found to increase with increasing Q-switched speeds, to decrease with increasing values of initial excitation, to increase with increasing loss for slow Q-switching speeds, and to decrease with increasing loss for fast Q-switching speeds. In all cases the bandwidth was much smaller than that associated with spontaneously occurring picosecond pulse. Criteria are developed for the validity of the linear analysis. Dissert. Abstr.

N71-21896# Radio Corp. of America, Lancaster, Pa. RCA Electronic Components.
DEVELOPMENT, CONSTRUCTION AND DEMONSTRATION OF A 100 WATT CW ARGON ION LASER Final Technical Report, 28 Feb. 1969 1 Jun. 1970
J. R. Fendley, Jr. and J. J. O'Grady Ft. Monmouth, N.J. ECOM Dec. 1970 107 p refs
(Contract DAAB07-69-C-0246; ARPA Order 1365)
(AD-717298; ECOM-0246-F) Avail: NTIS CSCL 20/5

The report covers the design, construction and evaluation of a continuous-duty output, multi-line, multi-transverse mode argon-ion laser. The double-ended unit employs modular construction, joining the anodes and having windows only at the cathode ends to minimize contamination. Power levels up to 98 watts were demonstrated. Operation without adjustment at power output of 90 watts was achieved for hours at a time. The plasma tube was operated for approximately 150 hours prior to shipment to Fort Monmouth. Small signal gain measurements and data in the near UV region were also obtained and tabulated. Empirical scaling formulas were developed and employed in extrapolating the parameters from smaller proven designs. A comparative analytical study of the performance of argon laser amplifiers and oscillators is reported. This study contemplated future operation up to 1000 watts output. Author (GRA)

N71-21897 University of Southern Calif., Los Angeles.
NONLINEAR ABSORPTION OF LASER RADIATION BY ORGANIC COMPOUNDS
Lloyd Huff (Ph.D. Thesis) 1969 149 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 70-5216

An experimental study was made to determine the transmission of several materials as a function of incident laser intensity. Studies were conducted on several classes of organic compounds, including indanthrone dyes and the amylose-iodine complex. The nonlinear absorption behavior of indanthrone was studied in detail. This compound exhibits the property of becoming opaque at intensities near ten megawatts per square centimeter. Consequently, this material is a candidate for use as a passive optical limiter. Asymmetric temporal shaping of the laser pulse transmitted by the indanthrone was investigated. A theoretical analysis of rate equation models was performed to explain these nonlinear absorption effects. For the materials in which the lifetimes were much less than the duration of the laser pulse, the steady-state solution of the equations was applicable. Dissert. Abstr.

N71-22131*# Raytheon Co., Sudbury, Mass. Equipment Development Lab.
DEVELOPMENT OF CO2 LASER DOPPLER INSTRUMENTATION DETECTION OF CLEAR AIR TURBULENCE Appendix D and Appendix E, Addenda to Final Report
C. Sonnenschein, A. Jelalian, and W. Keene 5 Jun. 1970 33 p refs
Contract NAS8-24742)
(NASA-CR-103091; ER70-4203) Avail: NTIS CSCL 20E

The work tasks involved in order to design, fabricate, test and deliver an experimental engineering model of clear-air turbulence pulse Doppler laser radar are discussed. The detection instrument utilizing the system design studies and the information obtained from the transmitter feasibility demonstration tests are described in terms of the transmitter and receiver. Effects of mechanical vibrations on the laser transmitter and components are analyzed including the nonparallel end mirrors, antenna degradation, pulse integration improvement, pulse-to-pulse correlation, and translational effects. J.M.

N71-22146# ILC, Inc., Sunnyvale, Calif.
OPTICAL PUMPS FOR LASERS Triannual Report, 15 Jan.–15 May 1970
Lowell Noble and John Richter Nov. 1970 52 p refs
(Contract DAAB07-70-C-0035)
(AD-717562; ECOM-0035-2; Rept-2) Avail: NTIS CSCL 20/5

The overall objective is to produce more efficient cw and pulsed optical pumps for Nd:YAG lasers. Both noble gases and alkali-metal vapor are being studied. The development of the alkali discharge as a cw pump has concentrated on optimizing the spectral output by varying the pressure. A potassium and rubidium filled lamp was found to give the best overlay with the absorption bands of Nd:YAG. Noble gas discharges have been investigated as pulse pumps. Xenon and krypton have been compared at input energies of 5, 10, and 20 joules, bore diameters of 3, 4, and 5 mm, gas pressures of 450, 700, 1500, and 3000 torr. Krypton was generally found to be approximately 20% more effective in exciting Nd:YAG. Author (GRA)

N71-22239# California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.
MODERN OPTICS Interim Scientific Report, 1 Jan. 31 Dec. 1969
Nicholas George Aug. 1970 31 p refs
(Grant AF-AFOSR-1492-68)
(AD-717775; AFOSR-70-2982TR) Avail: NTIS CSCL 20/5

Theoretical and experimental research is being conducted in the field of modern optics. The goal is to contribute solutions for important specific problems in the generation, propagation, properties, and uses of coherent electromagnetic radiation. Subjects of current interest are grouped into two main areas: holography and nonlinear optics. Specific new and continuing research in holography includes wide-angle holographic stereography and other forms of hybrid imaging, real image projection, blurred image restoration, conventional and real-time recording media, and cascaded input matched filtering. Specific new and continuing research in nonlinear optics includes saturation effects in magnetically tuned laser amplifiers, lasers for molecular spectroscopy and air pollution monitoring, electric-field-induced birefringence in liquids, and the intensity dependent index of refraction in solid dielectrics. The report summarizes the activity for the Calendar Year 1969. Author (GRA)

N71-22278# Air Force Weapons Lab., Kirtland AFB, N.Mex.
A LADAR CLOUD/TARGET POLARIZATION DISCRIMINATION TECHNIQUE Technical Report, Oct. 1964 – Apr. 1970
Joe E. Manz Oct. 1970 256 p refs
(AD-717707; AFWL-TR-70-76) Avail: NTIS CSCL 17/8

The use of laser detection and ranging (ladar) systems in the atmosphere is limited by the severe attenuation of the signal due to absorption by atmospheric gases and/or scattering by cloud and fog particles. Furthermore, the cloud and fog particles may scatter the transmitted radiation toward the receiver, thus producing a false return, which must be distinguished from the true target return. Described herein is an optical polarization technique for discriminating between a cloud return and a target return. Also presented are the results of a research program which demonstrated the validity of the discrimination technique both in the laboratory and in the field. The conclusion is that the cloud/target discrimination technique will greatly improve the capability of a ladar system to distinguish between an atmospheric cloud and a target. Author (GRA)

N71-22288# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
HOLOGRAPHIC APPLICATIONS IN SHADOWGRAPH, SCHLIEREN, AND INTERFEROMETRY ANALYSES OF HEAT TRANSFER AND FLUID FLOW TEST SUBJECTS
A. G. Havener Nov. 1970 45 p refs
(AD-717702; ARL-70-0270) Avail: NTIS CSCL 20/4

A folded conventional schlieren system was modified for transmission holography. Holograms of different test subjects, two heat transfer and two low supersonic flow studies, were made with direct undiffused laser light. Each event was reconstructed as a real image of the test and was analyzed using ordinary shadowgraph, schlieren, and interferometric techniques. Shadowgraph and schlieren photographs were obtained in two ways: first, a single hologram was double exposed and the interference was reconstructed directly from the hologram; second, two holograms were separately exposed and simultaneously realigned, and the interference was created between the holograms. Local values of density determined from the holographic interferograms agreed with previously known or theoretically calculated values. The shadowgraph and schlieren photographs agreed well with similar pictures of the same test subjects made with incoherent white light. Author (GRA)

N71-22407*# Raytheon Co., Sudbury, Mass. Equipment Development Labs.
WIDE BAND FREQUENCY TRACKER PERFORMANCE AND DESIGN OF AN ALL ANGLE LASER DOPPLER OPTICAL HOMODYNE RECEIVER; GROUND WIND AND WIND TUNNEL MEASUREMENTS PROGRAM, VOLUME 2 Final Report
J. D. Fridman, K. Meister, J. C. L. Shabeck, Jr., and R. Young 16 Dec. 1970 136 p refs
(Contract NAS8-21293)
(NASA-CR-103088; ER70-4286) Avail: NTIS CSCL 20E

The characteristics of wide band frequency trackers in order to determine their performance under flow and turbulence conditions extending from the subsonic to the supersonic are analyzed. All combinations of FM signals have been simulated across a very wide range of operating conditions to create typical Doppler shifted signals that can be generated in a laser Doppler velocimeter flow and turbulence measurement system. Both static and dynamic configurations have been studied and the results interpreted via appropriate theoretical models. The design and fabrication of an all angle laser Doppler velocimeter is discussed. The all angle LDV may be used for performing one-, two-, or three-dimensional flow measurements and for turbulence cross-correlation studies when used in conjunction with the 3-dimensional laser Doppler velocimeter. Author

N71-22610 Minnesota Univ., Minneapolis.
FLUID VELOCITY MEASUREMENT FROM THE DOPPLER SHIFT OF SCATTERED LASER RADIATION
R. J. Goldstein and D. K. Fried *In* AGARD Meas. Tech. in Heat Transfer Nov. 1970 p 459–486 refs (See N71-22598 11-33)
Copyright. Avail: Technivision, Braywick House, Maidenhouse, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The basic principles involved in the theory and application of the laser-Doppler system for the measurement of fluid velocity are reviewed. Optimization of the optical system geometry is calculated with respect to signal bandwidth, signal to noise ratio, sensitivity, and spatial resolution. Selection of suitable light scattering particles is discussed with respect to scattering efficiency and the extent to which the particles follow the flow. Various alternatives for spectrum analysis of the photomultiplier Doppler current are briefly discussed with regard to the type of velocity information sought. A review is given of the work which has been published in this area and data are presented to illustrate the type of information which can be obtained with the laser-Doppler system. Author

N71-22615*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INVESTIGATION AND CALCULATIONS OF BASIC PARAMETERS FOR THE APPLICATION OF THE LASER DOPPLER VELOCIMETER
James F. Meyers Washington Apr. 1971 61 p refs
(NASA-TN-D-6125; L-7441) Avail: NTIS CSCL 20E

A method is presented for determining the operating criteria necessary to operate a laser Doppler velocimeter. The basic theory used to determine the criteria is presented and programed in a computer program. The results of the program are obtained for the cross-beam technique in its three modes of operation. From the basic theory and the program, a test case was chosen to determine the best laser Doppler velocimeter to use for the test flow and the parameters required for proper operation. Author

N71-22638 Compagnie Generale d'Electricite, Essonne (France).
DIAGNOSTIC LASER, ACTUAL SITUATION OF METHODS UTILIZING THE DIFFUSION OF THE THOMPSON LIGHT [DIAGNOSTICS LASER, SITUATION ACTUELLE DES METHODES UTILISANT LA DIFFUSION THOMSON DE LA LUMIERE]
F. Rostas *In* AGARD New Exptl. Tech. in Propulsion and Energetics Res. Oct. 1970 p 271–297 refs In FRENCH; ENGLISH summary (See N71-22626 11-12)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The application of lasers in optical methods of plasma diagnostics is discussed, and a summary of the results obtained by using Thompson diffusion is presented. It is shown that the electron density, temperature, and ion temperature can be determined by using this method. The time and spatial resolution are considered excellent. Author

N71-22703# Air Force Cambridge Research Labs., Bedford, Mass.
A LASER SYSTEM FOR SATELLITE GEODESY
Robert L. Iliff 10 Nov. 1970 17 p refs
(AD-717693; AFCRL-70-0614; AFCRL-IP-168) Avail: NTIS CSCL 17/8

A novel laser system designed and developed for satellite illumination is based on the use of two ruby lasers. It obtains range with a Q-switched laser and angular information by photographing satellite-reflected high-energy normal-mode laser pulses against stellar fields. The Q-switched laser system, operated in a controlled multipulse mode, is capable of up to 10 range measurements in a single pumping period. This increases confidence in the validity of the measurements especially since they are obtained in the presence of the high background noise that is encountered in daylight range measurements. The difference in satellite range within a 400-microsec time frame has been observed by means of the multipulse approach. Author (GRA)

N71-22779*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
FREQUENCY GENERATION AND CONTROL: ATOMIC HYDROGEN MASER FREQUENCY STANDARD
C. Finnie *In its* The Deep Space Network, Vol. 1 15 Feb. 1971 p 73-75 refs (See N71-22766 11-30)
Avail: NTIS CSCL 20E

System considerations are described for a prototype hydrogen maser cavity tuner for use with the atomic hydrogen maser frequency standard. Author

N71-22895* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
AMPLITUDE MODULATED LASER TRANSMITTER Patent
Robert R. Bilderback, inventor (to NASA) Issued 12 Sep. 1967 (Filed 27 Dec. 1965) 5 p Cl. 250-199
(NASA-Case-XMS-04269; US-Patent-3,341,708; US-Patent-Appl-SN-516793); Avail: US Patent Office CSCL 20E

An apparatus for amplitude modulation of a diode laser is described. Modulation occurs when a voltage pulse forming and energy storage network is charged through a direct current power supply and is discharged periodically through a lasing diode. Discharge is accomplished by a switch in the form of a silicon controlled rectifier triggered by voltage pulses from a pulse generator. The current pulses are delivered to a modulating transistor in series with the lasing diode. The modulator varies the amplitude of the pulses in correspondence with the amplitude characteristics of the audio signal coupled to the transistor base.
Official Gazette of the U.S. Patent Office

N71-22957 California Inst. of Tech., Pasadena.
HOLOGRAPHY AND PHASE CONTRAST METHODS
Nicholas George *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 711-720 refs Supported by AFOSR (See N71-22901 11-07)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

A method is proposed for recording the phase contrast of an optical wave which has been perturbed by reflection from a rough surface or by propagation through a turbulent medium. The method consists of taking a hologram of the perturbed wave, monochromatic light is assumed, and then analyzing the phase contrast in the reconstructed wave. In principle, it is similar to Zernike's phase contrast method or the interference microscope, except that phase ambiguities are resolved, and thus very large phase fluctuations can be measured. Sample computations are presented to illustrate the method. Author

N71-22960 MB Associates, San Ramon, Calif.
AIRBORNE MEASUREMENT OF ATMOSPHERIC TURBULENCE FROM LASER DIFFRACTION PATTERNS
Sherman Gee *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 745-752 refs Sponsored by Tenn. Univ. Space Inst. (See N71-22901 11-07)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

A method for airborne measurement of atmospheric clear air turbulence utilizing a laser-radar system designed to measure trust gust velocities in directions transverse to the flight path is introduced. The proposed method employs the fact that the laser diffraction pattern, formed from light back-scattered from a volume of aerosol in turbulent air, exhibits a transverse motion having twice the speed of gross transverse velocity component of the scatterers. A simple device enables the motion of the diffraction pattern to be manifested in the frequency characteristics of the detected return signal. Distinct advantages inherent in the concept make it worthwhile to consider its application as an airborne remote sensing device for clear air turbulence. Author

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N71-21907# North Carolina State Univ., Raleigh.
EXPERIMENTALLY-DETERMINED PLASTIC WAVE VELOCITIES IN FULLY-ANNEALED 1100F ALUMINUM: STRIKER VELOCITY 89 FT/SEC TO 788 FT/SEC
W. L. Liddell, R. S. Steele, W. L. Bingham, and R. A. Douglas Dec. 1970 43 p refs
(Contract N0014-68-A-0187)
(AD-717328; TR-70-11) Avail: NTIS CSCL 20/12

A previously-reported experimental system for determining the large strains, surface rotations, strain rates, and plastic wave velocities during free-free axial impacts is used to investigate the behavior of fully-annealed small grain 1100F aluminum rods under impact conditions. The system employs in-surface diffraction grating strain transducers illuminated by a pulsed ruby laser, with the strain-surface rotation-time-dependent diffraction pattern recorded by high-speed streak cameras. Strain-time and plastic wave velocity-strain data are presented for free-free axial impacts of aluminum rods at striker velocities ranging from 89 ft/sec to 788 ft/sec. Strains to 5.5% and strain-rates to 2000/sec are recorded. The data is compared to previously-reported data as a means of establishing the validity of the experimental technique, and as corroboration of some of the existing data. Author (GRA)

N71-21914# Naval Research Lab., Washington, D.C.
MARINE CORROSION STUDIES: THE ELECTROCHEMICAL POTENTIAL OF HIGH PURITY METALS IN SEAWATER Interim Progress Report
J. A. Smith, R. E. Groover, T. J. Lennox, Jr., and M. H. Peterson Nov. 1970 18 p refs
(AD-717340; NRL-MR-2187) Avail: NTIS CSCL 11/6

A study was conducted in which the electrochemical potentials of high purity metals were determined in quiescent seawater. The

data are presented as histograms and as potential time graphs. The electrochemical potentials of many of the metals varied over a broad range, and therefore it is impractical to assign a specific potential value to many of the metals. A galvanic series is included, however, based on the data obtained from the histograms. Two of the metals, bismuth and tin, had relatively stable potentials in seawater, but further experimentation indicated their unsuitability as reference electrodes to monitor cathodic protection systems on ship hulls. Author (GRA)

N71-21943# Watervliet Arsenal, N.Y. Benet R and E Labs.
THE EFFECT OF STRAIN RATE AND TEMPERATURE ON YIELDING IN STEELS
David P. Kendall Nov. 1970 38 p refs
(AD-717303; WVT-7061) Avail: NTIS CSCL 11/6

The effect of elastic strain rates ranging from 0.001 to 10/sec and temperatures ranging from 200K (-100F) to 590K (600F) on the yield strength of several steels is reported. The steels utilized are a 1018 mild steel, 4340 steel, H-11 tool steel and 300 grade maraging steel. The results are interpreted in terms of the Cottrel-Bilby yielding model based on release of dislocations from locking carbon atmospheres. The results for all of the materials except the maraging steel are consistent with this model if it is modified to account for re-locking of dislocations by migration of carbon atoms. The maraging steel shows a constant strain rate sensitivity at a constant temperature, over the range of strain rates investigated. This rate sensitivity decreases with increasing temperature and at 590K (600 F) a decreasing strength with increasing strain rate is found. This is attributed to stress aging effects. Author (GRA)

N71-21944# Cornell Univ., Ithaca, N.Y. Dept. of Materials Science and Engineering.
THE INITIAL STAGES OF THE OMEGA PHASE TRANSFORMATION IN Ti-V ALLOYS
Kerry K. McCabe and Stephen L. Sass Jan. 1971 24 p refs /ts Mater. Sci. Center No. 1413
(Contract N00014-67-A-0077-0012)
(AD-717353; TR-3) Avail: NTIS CSCL 11/6

The as-quenched omega phase and its transition to the aged form of the omega phase was examined using selected area diffraction and dark field electron microscopy. Author (GRA)

N71-22078*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FATIGUE OF FOUR STAINLESS STEELS, FOUR TITANIUM ALLOYS, AND TWO ALUMINUM ALLOYS BEFORE AND AFTER EXPOSURE TO ELEVATED TEMPERATURES FOR UP TO THREE YEARS
Walter Illg and L. A. Imig Washington Apr. 1971 66 p refs
(NASA-TN-D-6145; L-7613) Avail: NTIS CSCL 11F

Tensile specimens and unnotched, notched, spotwelded, and fusion-welded fatigue specimens from sheets of four stainless steels, four titanium alloys, and two aluminum alloys were tested at room temperature before and after exposure to elevated temperatures for up to 3 years. The steels and titanium alloys were exposed at 560 K (550 F) and the aluminum alloys were exposed at 390 K and 420 K (250 F and 300 F). Fatigue data covering a range of fatigue lives from 1,000 to 10 to the 7th power cycles were obtained before and after 3 years of exposure. The fatigue strengths after exposure were essentially the same as those before exposure. Author

N71-22175# Army Foreign Science and Technology Center, Washington, D.C.
EFFECT OF TIN ON PROPERTIES OF Mg-Li-Al ALLOYS
M. E. Drits et al 17 Feb. 1970 19 p refs Transl. into ENGLISH from the book "Vliyanie Olova na Svoistva Splavov" Moscow, 1968 p 191-199
(AD-717593; FSTC-HT-23-239-70) Avail: NTIS CSCL 11/6

The effect of tin on the properties of Mg-5% Li-5% Al alloy, and also in the simultaneous presence of small quantities of zinc and manganese, is investigated. Additives of zinc to alloys containing tin have a favorable effect on the plasticity of alloys, particularly those containing tin and manganese simultaneously. Small quantities of manganese, in addition to the favorable effect on the stabilization of properties, can have a positive effect on the corrosion resistance of alloys. The best combination of properties is displayed by the six-component alloy of the Mg-Li-Al-Mn-Zn-Sn system. Author (GRA)

N71-22238# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE METALLURGY OF TITANIUM [METALLURGIYA TITANA]
V. A. Garmata et al 27 Nov. 1970 830 p refs Transl. into ENGLISH of the Russian Monograph
(AD-717831; FTD-HC-23-352-69) Avail: NTIS HC $9.00/MF $0.95 CSCL 11/6

The book analyses problems connected with the preparation of titanium-containing raw material for chlorination. The production of titanium tetrachloride, metallothermal methods of producing refining, and smelting titanium are examined. Methods of electrolytic production and refining titanium, the processing of titanium waste and titanium base alloys, and production of pigmentary titanium dioxide from titanium tetrachloride are described. Attention is paid to the properties of titanium and titanium-base alloys and the fields of their utilization. Author (GRA)

N71-22242# Washington Univ., Seattle. Dept. of Physics.
ELECTRONIC STRUCTURE OF DISORDERED ALLOYS Final Scientific Report
E. A. Stern 18 Jan. 1971 8 p refs
(Grant AF-AFOSR-1270-67)
(AD-717761-AFOSR-TR-71-0001) Avail: NTIS CSCL 20/12

Polar reflection Faraday effect measurements in Ag-Cd and Ag-Mg alloys have shown that the Fermi surface is well defined even for concentrated alloys. Formation of a second set of necks at 1.3 electron-per-atom ratio is indicated. Optical constant and residual resistivity measurements on disordered alloys were begun. Second harmonic light generation measurements at metal surfaces were begun and a theory completed. Magneto-optic Kerr effect in nickel and gadolinium was studied. Author (GRA)

N71-22290# Idaho Nuclear Corp., Idaho Falls.
METALLURGY AND MATERIALS SCIENCE BRANCH Annual Report, Fiscal Year 1970
W. C. Francis, ed. Nov. 1970 75 p refs
(Contract AT(10-1)-1230)
(IN-1437) Avail: NTIS

The research and development of materials to be used in the construction of nuclear reactors is discussed. Subjects presented are: (1) metallurgical development, (2) electron beam welding, (3) axial fatigue of irradiated stainless steels tested at elevated temperatures, (4) surveillance of test reactor beryllium and hafnium, (5) aluminum foils as controllable neutron absorbers, (6) irradiation tests of nuclear reactor materials, and (7) failure analysis of materials. Author

N71-22291 Missouri Univ., Columbia.
A STUDY OF THE RATIO OF THE THERMAL ACCOMMODATION COEFFICIENTS OF HELIUM (4) AND HELIUM (3) ISOTOPES ON BARE TUNGSTEN FROM 77 K TO 513 K

Charles Leon Krueger (Ph.D. Thesis) 1969 80 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 70-6594

Determinations of the ratio of over 600 pairs of thermal accommodation coefficients of the He(4) to He(3) isotopes on clean tungsten, taken at sixteen temperatures ranging from 77 K to 513 K, are reported. These determinations at low and moderate temperatures are made at the clean surface limit, using mischmetal getter technique. At the highest temperatures, corresponding pairs for the ratios were measured at equal time intervals following flash, during slow, constant rates of rise of the coefficients, so that the small adsorption effects cancel for the two species. Reasons are advanced for the ratio of the coefficients being more accurately determinable than the coefficients themselves. Dissert. Abstr.

N71-22298# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ACTION OF MIXTURES OF INHIBITORS
Yu. V. Fedorov 16 Nov. 1970 27 p refs Transl. into ENGLISH from Tr. Mezhdunar. Kongress Korrozii Metallov, 3d (USSR), v. 2, 1968 p 150 - 162
(AD-717830; FTD-HT-23-701-70) Avail: NTIS CSCL 11/6

The influence of mixtures of surface-active and anion-active, molecule-active and anion-active substances on steel corrosion in acid solutions are studied. The mutual intensification of the inhibiting action of the mixtures tribenzylamine, sodium napthalene-sulfonate, and halide ions; mixtures of indole, ammonium rhodanide, and halide ions is explained. Principles are proposed for selecting mixtures of iron inhibitors in acid solutions with consideration of the particle charge of the mixture components. The advantage of using L. I. Antropovs reduced potential scale is shown in studying the effect of the inhibitor mixtures on acidic corrosion of metal and in explaining the active principle in complex inhibitor mixtures. Author (GRA)

N71-22354# Johns Hopkins Univ., Baltimore, Md. Dept of Mechanics.
AN EXPERIMENTAL AND THEORETICAL STUDY OF THE PARABOLIC GENERALIZATION FOR THE PLASTIC DEFORMATION OF METALS Final Report, 1 Aug. 1966 - 31 Jul. 1970
James F. Bell 31 Jul. 1970 26 p refs
(Contract AF 49(638)-1715)
(AD-717752; AFOSR-TR-71-0080) Avail: NTIS CSCL 11/6

The results of several years of research are briefly described and shown to provide a solid experimental foundation for the subject of crystal plasticity. A unifying generalization has been established in the form of a linearly temperature dependent parabolic stress-strain function which is applicable to the finite deformation of many crystalline solids. The interrelation of this generalization with many topics of crystal plasticity is discussed. These topics include: the double slip deformation hypothesis for face-centered cubic single crystals; the polycrystalline aggregate theory; plane wave, incompressible dynamic plasticity; the finite deformation mode and transition structure; the quantized structure of zero point isotropic shear moduli; the Portevin - Le Chatelier effect; deformation of binary alloys; combined tension-torsion stress states; tensile plastic waves and dynamic plasticity at elevated temperatures. Author (GRA)

N71-22355# Illinois Univ., Urbana. Dept. of Metallurgy and Mining Engineering.
THE STUDY OF POINT DEFECTS IN CsCL ORDERED ALLOYS AND OTHER INTERMETALLIC COMPOUNDS Final Report, 1 Jun. 1968 - 31 Aug. 1970
David S. Lieberman Dec. 1970 12 p refs
(Grant AF-AFOSR-1599-68)
(AD-717757; AFOSR-TR-71-0004) Avail: NTIS CSCL 20/12

Simultaneous radioactive trace diffusion studies of various isotopes of both species in two intermetallic compounds, AuZn and FeCo, were completed. In the former, correlation effects were also analyzed and in the latter, the isotope effect was measured. In the ordered region of FeCo and in the AuZn (also ordered) alloys, the agreement between observations and the theoretical six-atom-vacancy jump mechanism lends strong support to this model. An analysis of line and plane defects produced in situ with the field ion microscope was made and the application of a computer simulation technique was completed. The kinetics of the stabilization of the low temperature product phase following the beta to beta double prime transformation in equiatomic AuCd were successfully accounted for in terms of the annealing out of point defects introduced by the movement of the transformation interface on cooling. Author (GRA)

N71-22356# Avco Corp., Wilmington, Mass. Systems Div.
NONDESTRUCTIVE TEST TECHNIQUE DEVELOPMENT BASED ON THE QUANTITATIVE PREDICTION OF BOND ADHESIVE STRENGTH Annual Technical Report, 21 Jul. 1969 - 20 Jul. 1970
John R. Zurbrick 20 Jul. 1970 119 p refs
(Contract N00156-69-C-0913; ARPA Order 1247)
(AD-717663; AVSD-0331-70-RR) Avail: NTIS CSCL 14/2

Results of a Surface Condition Study on 6061-T6 aluminum alloy butt tensile, core shear, and single lap shear specimens of various roughnesses, bonded with an Epon 828/DETA formulation, have supported the creation of a practical equation for predicting bond adhesive strength (Zurbrick). Major controlling variables, i.e. substrate surface free energy, contact angle, and bondline thickness, are all potentially measurable nondestructively. A strong correlation between white light specular reflection values and values of aluminum substrate surface free energy calculated from experimental data was obtained, encouraging extensive investigation of this NDT technique. Exo-electron emission, ultrasonic gas-phase transmission, and electric field reflectometry techniques were also evaluated in continuing feasibility studies. Author (GRA)

N71-22372# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SELECTIVE TRANSFER EFFECT AT POINTS OF FRICTION [IZBIRATELNYI PERENOS V UZLAKH TRENIYA]
D. N. Garkunov et al 20 Nov. 1970 114 p refs Transl. into ENGLISH from the Russian
(AD-717827; FTD-HC-23-246-70) Avail: NTIS CSCL 11/6

The booklet brings to light a new phenomenon discovered namely, the effect of selective transfer of metals under friction, which sharply reduces the wear of components. It reveals the mechanism of this phenomenon and the authors describe the principles governing it and its practical applications. By this phenomenon, it has become possible with the friction method to deposit thin, lubricating layers of copper, brass or bronze on steel surfaces, for purposes of increasing the protective properties of the components. Selective transfer is used as a means of reducing wear of components with the application of metal plating lubricants containing bronze or brass powders. Author (GRA)

N71-22399 National Lending Library for Science and Technology, Boston Spa (England).
ALLOYS OF BERYLLIUM WITH IRON
W. Kroll 2 Apr. 1970 9 p Transl. into ENGLISH from Wiss. Veroeff. Siemens-Werken (Berlin), v. 8, 1929 - 1930 p 220 - 235
(NLL-Trans-564-(5206.6)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Beryllium steels containing 1.2% to 3.9% of beryllium were considerably deformed by rolling or forging. Rolling was successful up to 3.0% Be, while the alloy with approximately 3.9%

Be was malleable only with difficulty. The structures of all the alloys were coarse grained. The test pieces were kept at 1100 C for 1/2 hour, and then quenched in water. Hardness was determined with a load of 1000 kg. Then the test pieces were aged for 1 hour at 520 C. One section of the material was annealed for 1 hour at 950 C. From this it was seen that age-hardening increases with increasing beryllium content, and that it is very small, especially in the low percentage alloys with 1.21% beryllium. To obtain a hardness corresponding to that of a 1% carbon steel after quenching, at least four times that quantity of beryllium must be used. Author

N71-22481# Maryland Univ., College Park.
INTERFACES ASSOCIATED WITH ORDERED ALLOYS
M. J. Marcinkowski 24 Dec. 1970 46 p refs Presented at the 7th Intern. Congr. on Electron Microscopy, Grenoble, France, 2 Sep. 1970
(Contract AT(40-1)-3935)
(ORO-3935-4; CONF-700809-5) Avail: NTIS

An analysis was made of the various types of interfaces existing in several of the more common superlattice types. Superlattice dislocations, tilt and twist boundaries, dislocation networks, grain boundaries, twinning and martensitic transformations as well as thermally produced antiphase boundaries were considered in detail. The electron diffraction contrast effects arising from the antiphase boundaries and dislocations comprising these various types of interface were also analyzed in depth. Author

N71-22482# North Carolina Univ., Chapel Hill.
ACTIVITY COEFFICIENT AND VACANCY FLOW EFFECTS ON TRACER DIFFUSION IN SILVER GOLD ALLOYS
Marvin H. Greene (Ph.D. Thesis) 1970 78 p refs Sponsored by AEC
(ORO-2036-20) Avail: NTIS

The diffusion runs were carried out under a pressure of about 1500 psi and determination of the original interface was accomplished by using radioactive hafnium oxide as an inert marker. Temperature measurement of the samples was effected by using tracer self-diffusion measurements coupled with the known diffusion data for the system. Results obtained with the silver tracer show a profile shift of about 58 microns, which is in good agreement with Manning's theoretically predicted profile shift of approximately 60 microns employing mean drift analysis. The results with the gold tracer, however, did not agree with theory as well as those of the silver tracer. This disagreement is attributed to a rather large pore formation that occurred around the couple interface. The results of the experiment were also examined by a diffusion coefficient analysis. Author

N71-22490# National Aeronautical Establishment, Ottawa (Ontario).
CYCLITIC OXIDATION OF Cr-Ti-Si COATINGS ON THE NIOBIUM ALLOY B66
J. M. Trenouth and R. V. Dainty Nov. 1970 98 p refs
(NRC-11732; MS-131) Avail: NTIS

Cr-Ti-Si diffusion coatings, formed on the niobium alloy B66 by a two cycle vacuum pack cementation process, were evaluated by cyclic oxication tests at both 1204 and 1371 C. Coating protection was found to be a function of the thickness of the initial Cr-Ti coating at 1204 C but independent of this thickness above a minimum value at 1371 C. At both temperatures coating lifetimes were independent of compositional variations in coatings effected by coating parameter variations. The lifetimes of specimens correlated with those obtained by other investigators of this system for comparable coating thicknesses. However it was apparent that greater lifetimes would be obtained with a heavier silicide coating than that used on the current specimens. Modification of the silicide zone of Cr-Ti-Si coatings by elements that would promote formation of a vitreous scale was suggested as a coating improvement. Author

N71-22510# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
MAGNETIC PHENOMENA AT METAL SURFACES Technical Progress Report, 1 Feb. – 31 Dec. 1970
Stephen Spooner 1 Jan. 1971 94 p refs
(Contract AT(40-1)-3674)
(ORO-3674-4) Avail: NTIS

Cobalt films deposited on glass substrates and on a copper single crystal subetrate were studied with torque magnetometry. Glass substrate specimens, studied with respect to evaporation geometry, showed that magnetic property uniformity can be expected for neutron mirror films. A copper single crystal substrate specimen exhibited epitaxial effects through the observation of a significant sin 6 theta component in planar torque-angle curves. At the same time, a completely rotatable anisotropy axis has been observed which is reminiscent of stripe domain structure arising from perpendicular anisotropy. A monochromated neutron beam facility was completed for continued neutron mirror studies. Fundamental studies of Ising model behavior brought about by crystalline anisotropy in FeCO3 confirmed the Ising model character of inelastic magnetic scattering from FeCO3. The magnetic excitations below the Neel temperature are found to be without dispersion. No single sharp inelastic scattering peak could be found above the Neel temperature. Low temperature studies were undertaken on MnC12-H2O in which the magnetic structure and the spontaneous orientation of the Mn atomic moments were determined through Bragg diffraction measurements at 1.2 K. Author

N71-22579# South Carolina Univ., Columbia. Coll. of Engineering.
POWDER METALLURGY COMPACTION Quarterly Progress Report, 1 Sep. – 30 Nov. 1970
E. G. Schwartz, Kenneth L. Wilson, James B. Hornsby, and Tse-Bor Ni 30 Nov. 1970 26 p ref
(Contract AT(38-1)-475)
(SRO-475-9) Avail: NTIS

The reported results of a continuing program of research include: (1) The data obtained for die translation versus static compaction are presented and show a definite reduction of die wall friction using a suspension of aluminum stearate in dodecyl alcohol as a lubricant. (2) Investigations were made on the die wall friction reducing capabilities of superimposed vibrations when a proper combination of frequency and amplitude are employed. The data obtained indicates little advantage in oscillated vs. static processes for compacting powdered metals. (3) Studies aimed at a stress analysis of powder undergoing compaction resulted in the specification of a yield criterion. An emperical description of yield criterion is given and an analytic expression is outlined. D.L.G.

N71-22582# Cornell Univ., Ithaca, N.Y. Materials Science Center.
APPLICATION OF PSEUDOPOTENTIALS TO CALCULATION OF VACANCY FORMATION ENERGY AND VOLUME FOR ALKALI METALS
Paul S. Ho Nov. 1970 31 p refs Sponsored by AEC
(NYO-4185-2; Rept-1486) Avail: NTIS

Based on the pseudopotential formalism a calculation was formulated for vacancy formation energy and formation volume in metals. The calculation is carried out in three steps: First the structural energy required to create the vacancy is calculated; then the lattice-statics method is used to calculate the vacancy relaxed configuration and the energy; finally the dilatation of the whole defect lattice is determined according to the equilibrium condition. When applying this calculation to alkali metals, it was found that: (1) the contribution from the volume-dependent lattice energy to the vacancy formation energy is very large as compared to that due to relaxation around the vacancy, and therefore such energy must be considered in calculating vacancy volume and energy; and (2) the relaxed displacements near the vacancy are highly anisotropic and quite large but such relaxation energy contributes only about 25% of the formation energy. For pseudopotentials in the

calculation, a local potential and an optimized non-local potential were chosen; both of which were corrected for the electron exchange and correlation interactions in the screening function. The results are in quantitative agreement with the available experimental measurements of alkali metals. Author

N71-22583# Cornell Univ., Ithaca, N.Y. Materials Science Center.
OBSERVATION OF VOID FORMATION INDUCED BY ELECTROMIGRATION IN METALLIC FILMS
P. S. Ho and L. D. Glowinski 1 Sep. 1970 14 p refs Sponsored by AEC
(NYO-4185-1; Rept-1447) Avail: NTIS

Observation was made on void formation induced by electromigration in single crystal and bicrystal (100) Au films and polycrystalline Al films. In the Au film, voids were observed to be bound by crystal planes with low surface energies and dislocations appeared to be the preferred sites for void formation. In the Al film, void formation was observed to initiate at grain boundaries or grain boundary junctions. Under the experimental conditions, the formation of voids and hillocks is determined by the local concentration of defects at the grain boundary but the overall effect is determined by the divergence of the diffusion flux under a temperature gradient. Author

N71-22594*# Technion - Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.
CREEP OF Au-4G1 ALUMINUM ALLOY UNDER INCREMENTAL VARIATION IN STRESS Final Report
Auraham Berkovits Oct. 1970 30 p refs
(Grant NGR-52-012-002(2))
(NASA-CR-117838; TAE-117) Copyright. Avail: NTIS CSCL 11F

Incremental loading tests were performed on AU-4G1 aluminum alloy sheet specimens subjected to tensile creep at 473 K. Tests consisted of changing the axial stress by a small amount, by either loading or unloading, during primary creep. Results were similar to those obtained previously on commercially pure aluminum. Incremental strain response due to a small increase in stress was essentially linear viscoelastic, while unloading caused cessation of creep straining for a time, following by linear viscoelastic creep. Material stiffness increased during creep, indicating that strain hardening was taking place. For axial stress in the plastic range of the material, the modulus increased with time from an initial inelastic value and approached to the elastic modulus. Author

N71-22595 National Lending Library for Science and Technology, Boston Spa (England).
CORROSION IN A FLUORINATING MEDIUM. 11: EXPERIMENTAL METHODS
L. Vincent et al 9 Mar. 1970 35 p refs Transl. into ENGLISH from Energie Nucl. (Paris), v. 11, no. 7, Oct. 1969 p 411–422 In ENGLISH and FRENCH
(NLL-CA-232-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 5 NLL photocopy coupons

Technologies are reviewed which are characterized by modifications necessitated by their applications in gaseous diffusion isotope separation plants to obtain both kinetic data and data on the nature and structure of the reaction products. Technologies employing fluorinating gases, glove box manipulation, corrosion apparatus, sample preparation, weighing techniques and problems, continuous kinetic measurements, morphological studies, analysis and characterization of reaction products, and analysis and purification of the gaseous phase are discussed. It is felt that the methods form one, complementary whole, and are capable of contributing to the chemistry of fluorine. N.E.N.

N71-22661# Michigan Univ., Ann Arbor. Dept. of Mechanical Engineering.
THEORETICAL AND EXPERIMENTAL STUDY OF FILM CONDENSATION OF LIQUID METAL VAPORS Annual Progress Report
George S. Springer Dec. 1970 13 p refs Sponsored by AEC
(COO-2032-6) Avail: NTIS

A solution to the Boltzmann equation was determined to obtain condensation and evaporation coefficients for plane and spherical surfaces, and to relate them to heat and mass transfer rates. The calculations were extended to include vapor mixtures and diatomic vapors. Thermal forces acting on small particles were also calculated. Experimental work was performed to evaluate the theoretical results and to determine surface temperature, heat transfer rates, and density distributions through monatomic and diatomic gases. N.E.N.

N71-22794 Georgia Inst. of Tech., Atlanta.
A MOESSBAUER INVESTIGATION OF ATOMIC ORDERING EFFECTS IN THE IRON-COBALT ALLOY SYSTEM
Benjamin de Mayo (Ph.D. Thesis) 1969 86 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 70-8018

Composition dependent studies were made between 25 and 75 atomic percent cobalt, and a detailed study as a function of atomic order was made on the equiatomic alloy Fe(50-50)Co. The effective magnetic field at the iron nuclei, the isomer shift, the quadrupole splitting, and the shapes of the absorption lines of the spectra were measured for the alloy samples. It was found that in this composition region: the effective field and isomer shift are reduced in magnitude with increasing order or with increasing cobalt concentration; the quadrupole splitting is unaffected by ordering or by composition changes; and disordering broadens the absorption lines and ordering narrows them. The results indicate that local atomic configurations play a significant role in the competition between various contributions to the hyperfine interactions. The data imply positive local spin polarization contribution. Dissert. Abstr.

N71-22795 California Univ., Los Angeles.
INTERSTITIAL DIFFUSION IN METALS, HYDROGEN IN TITANIUM
Joseph Lewis Waisman (Ph.D. Thesis) 1969 263 p
Avail: Univ. Microfilms: HC $11.95/Microfilm $3.40 Order No. 70-8220

A theoretical and experimental study was conducted to determine the combined effects on diffusion of interstitials in metals, of gradients in interstitial concentration, in solvent composition, in stress, and in temperature. The theory developed was based on macroscopic irreversible thermodynamics, and is applicable to a polycrystalline material or a single crystal, to single or multiple phases, and to anisotropic or isotropic symmetry. Special equipment was developed for making measurements of the change in the pressure of hydrogen gas in equilibrium with the solid in titanium-hydrogen solid solutions from 600 to 800 C. The stress tests showed an increase of hydrogen pressure with an application of a compressive stress, a decrease of pressure with a tensile stress, and no effect of torsion. Dissert. Abstr.

N71-23046* Hughes Aircraft Co., Culver City, Calif.
MULTILAYER POROUS IONIZER Patent
Otto K. Husmann, inventor (to NASA) Issued 14 Jan. 1969 (Filed 7 Jun. 1965) 7 p Cl. 29-182.2; Int. Cl. B22f3/00; Int. Cl. B22f5/00; Int. Cl. B22f7/00 Sponsored by NASA
(NASA-Case-XNP-04338; US-Patent-3,421,864; US-Patent-Appl-SN-461765) Avail: US Patent Office CSCL 11F

A multilayer porous refractory metal ionizer is described for vapor phase contact ionization purposes. An ion source is comprising at least two center layers is provided in which one of these layers, the substrate, is thick and porous, and is composed of large-sized grains. The layer on the substrate is relatively thin,

and porous, and has grains of micron size. Both materials are refractory metals such as tungsten.
Official Gazette of the U.S. Patent Office

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 08 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N71-21866# North Carolina State Univ., Raleigh.
MICROSTRUCTURAL ALTERATIONS IN ALUMINA CERAMICS ASSOCIATED WITH BALLISTIC IMPACT EVENTS
Chong Hee Kim and H. Palmour, III Dec. 1970 62 p refs
(AD-717325; TR-70-8) Avail: NTIS CSCL 19/4

Surface topography and defect structures associated with ballistic impact in a commercial 94 percent alumina ceramic armor are described. Fracture surfaces were examined by scanning electron microscopy, augmenting previous replication electron fractography studies. Direct transmission electron microscopy was employed in characterizing defect structures in extracted fracture fragments on replicas and in thin foils taken from bulk polycrystalline alumina in undamaged and damaged states. A variety of dislocation interactions and tangled masses of dislocations with densities as high as 2 x 10 to the 11th power/sq cm have been observed near intersecting surfaces in thin fracture fragments. Similar deformation textures within the bulk have been observed in impact-damaged alumina for a distance of at least 20 micrometers beneath a fracture surface. Localized plastic flow is most prominently evidenced in the case of cracks which are intersecting at acute angles to create fracture fragments, and in worked zones abutting propagating cracks in more massive material. These observations strongly support the concept that portions of the high stresses concentrated at the tips of propagating cracks during an impact event are relaxed by plastic deformation processes, thereby absorbing excess energy and/or delaying the fracture process to some degree. Author (GRA)

N71-21871# Boeing Scientific Research Labs., Seattle, Wash.
ENTROPIC SEGREGATION OF POLYDISPERSE POLYMERS NEAR OBSTACLES
James M. Peterson Dec. 1970 39 p refs
(AD-717284; DI-82-1031) Avail: NTIS CSCL 7/4

In deference to simplicity, discussions here are limited to systems containing linear, unbranched polymer molecules, although in principle branched systems can also be treated. It will be shown that longer molecules near an obstacle suffer a relatively greater conformational restriction than do shorter molecules. Hence in a system containing molecules of different lengths, there exists a thermodynamic preference for regions near impeding surfaces to be richer in shorter molecules than the bulk of the material. Such regions would display a lower degree of molecular entanglement which fact would lead to a corresponding decrease in cohesive strength for the interfacial region and thus a reduced strength of the adhesion. Here the thermodynamic limit of this mechanism is explored to determine how much enrichment of surface areas with short molecules can occur. The report may have application to a number of important problems involving the adhesion of polymers to various surfaces. The entropic force described would be expected to cause a relatively weak surface layer at the boundary of an adhesive which might result in so-called adhesive failure. Heretofore such failures have been assumed to result from some contamination or improper surface preparation. The work shows that the failure may well be caused by a weak boundary layer in the polymeric adhesive. GRA

N71-21929# Pennsylvania State Univ., University Park. Materials Research Lab.
MATERIALS PREPARATION AND CHARACTERIZATION RESEARCH Technical Summary Report, 1 Jul. -31 Dec. 1970
Rustum Roy 31 Dec. 1970 31 p refs
(Contract DA-49-083-OSA-3140; ARPA Order 338)
(AD-717647) Avail: NTIS CSCL 11/2

Briefly summarized is research concerned with such topics as: preparation of silica glass from amorphous silica; Glass structure by Raman spectroscopy; Hydrogen impregnation of glass; Effect of oxygen on the structural behavior of Ge-Te glasses; Materials based on CdF2; Bismuth titanate ferroelectrics; Silver iodide crystals; Vapor phase growth; Refractory optical host materials; Hydroxyapatite; Calcite; Characterization of single crystals with a double crystal spectrometer; Characterization of residual strain. GRA

N71-21937# Boeing Scientific Research Labs., Seattle, Wash. Materials Sciences Lab.
CYCLOPOLYCONDENSATION
Paul M. Hergenrother Jan. 1971 63 p refs
(AD-717641; DI-82-1036) Avail: NTIS CSCL 7/3

The report was prepared as one of seven chapters in a book entitled Kinetics and Mechanisms of Step-growth Polymerization edited by D. H. Solomon to be published by Marcel Dekker, Inc. in 1971. Polyimides, polybenzimidazoles, and polyquinoxalines are three important families which are discussed as well as a number of other polymers which may prove to be even more important in the future. Author (GRA)

N71-21984*# Martin Marietta Corp., Denver, Colo.
LOW THERMAL FLUX GLASS-FIBER TUBING FOR CRYOGENIC SERVICE Final Report
C. A. Hall, T. J. Pharo, J. M. Phillips, and J. P. Gille 31 Mar. 1971 215 p refs
(Contract NAS3-12047)
(NASA-CR-72797) Avail: NTIS CSCL 11D

Thin metallic liners that provide leak-free service in cryogenic propulsion systems are overwrapped with a glass-fiber composite that provides strength and protection from handling damage. The resultant tube is lightweight, strong, and has a very low thermal flux. The resultant reduced boiloff of stored cryogenic propellants yields a substantial weight savings on long-term missions (7 days or greater). Twelve styles of tubing ranging from 1.27 to 12.7 cm in diameter were fabricated and tested at operating temperatures from +70 to −423 F and operating pressures up to 3000 psi. Author

N71-22011# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LUBRICATING OILS FOR JET ENGINES [SMAZOCHNYE MASLA DLYA REAKTIVNYKH DVIGATALEI]
E. N. Kalaitan 23 Dec. 1970 237 p refs Transl. into ENGLISH from the Russian
(AD-717835; FTD-HC-23-1296-68) Avail: NTIS CSCL 11/8

The report describes briefly the construction and principles of operation of aviation gas turbine engines, their assemblies and friction points, and also the oil systems. Operating conditions of lubricants in these engines are discussed, as are the functions of oils as lubricating materials, the functions of operating liquids and cooling agents; technical specifications required of lubricants are discussed. Questions are discussed related to the assortment and quality of oils currently employed for aviation gas turbine engines and the requirements for oils of the near future. Methods are described for obtaining from petroleum and synthetics high-quality oils which possess high anti-oxidation, viscosity-temperature, anti-wear and other properties. Information is presented concerning additives which improve the operational properties of oils for aviation gas turbine engines. Domestic and foreign methods of

investigating and testing oils under laboratory conditions, and also in special stands and devices are systematized and described. GRA

N71-22077# Whittaker Corp., San Diego, Calif. Research and Development Div.

VISCOELASTIC WAVE PROPAGATION IN UNIDIRECTIONAL COMPOSITES Technical Report, Jun. 1969–Jun. 1970

Juan Haener Wright-Patterson AFB, Ohio AFML Sep. 1970 29 p refs

(Contract F33615-69-C-1367)

(AD-717760; MJO-3004; AFML-TR-68-311) Avail: NTIS CSCL 11/4

In the paper, functions describing the dilatational wave and the distortional wave in both the reinforcement and matrix have been assumed. These functions, and the associated stresses and displacements, automatically satisfy the symmetry conditions and four of the six boundary conditions. By means of these functions, the six dispersion equations are reduced to two transcendental equations, describing the boundary conditions at the interfaces. Author (GRA)

N71-22078# Stevens Inst. of Tech., Hoboken, N.J. Dept. of Chemistry and Chemical Engineering.

THE SYNTHESIS AND THERMAL DEGRADATION OF SOME FERROCENE CONTAINING POLYAZINES AND POLY SCHIFF BASES

R. G. Gamper, P. T. Funke, and A. A. Volpe 15 Nov. 1970 16 p refs

(Contract N00014-68-A-0131)

(AD-717648; TR-20) Avail: NTIS CSCL 7/3

A series of ferrocene-containing polymeric azines and polymeric Schiff bases were synthesized by means of acid-catalyzed solutions poly-condensations. The molecular structures of the synthesized polymers have been determined and information concerning their thermal behavior has been obtained. Comparative thermal stabilities of the products of polymerization of aliphatic and aromatic diames with 1,1'-diformylferrocene and 1,1'-diacetylerrocene were investigated by thermogravimetric analyses both in air and in an inert atmosphere. In the inert atmosphere, initial weight loss due to thermal stress did not occur below 300 C in all cases and in many cases 50-70 % residue of polymer sample remained at 700 C. The use of a fluorinated diamin led to the synthesis of a polymer which did not exhibit any significant enhancement of thermal properties. Investigation of the polymer products by direct inlet mass spectroscopy led to the observation that several of the systems contained significant amounts of cyclic dimers, although linear polymers were the major products in most cases. Extraction of the cyclic dimers followed by molecular weight determinations by vapor-phase osometry confirmed their molecular structures. Author (GRA)

N71-22079# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EFFECT OF SURFACE-ACTIVE LUBRICANTS ON THE CONTACT FATIGUE LIFE OF HARDENED BALL-BEARING STEEL

G. V. Karpenko et al 16 Nov. 1970 8 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Ukr. RSR, Ser. Fiz. Tekhn. Matematichni Nauki (Kiev), v. 31, no. 11, 1969 p 1042 1044

(AD-717824; FTD-HT-23-423-70) Avail: NTIS CSCL 11/8

The addition of up to 0.2 percent stearic acid to industrial oils reduced the contact fatigue limit of steels. Concentrations of 0.2-0.3 percent had no effect. The effect of steric acid addition was reduced on steels of higher purity. Author (GRA)

N71-22080# Stevens Inst. of Tech., Hoboken, N.J. Dept. of Chemistry and Chemical Engineering.

RECYCLE GEL PERMEATION CHROMATOGRAPHY. PART 1: RECYCLE PRINCIPLE AND DESIGN. PART 2: ANALYSIS OF EPOXY RESINS

J. A. Biesenberger, M. Tan, I. Duvdevani, and T. Maurer Dec. 1970 17 p refs

(Contract N00014-68-A-0131)

(AD-717630; TR-22-Pt-1-Pt-2) Avail: NTIS CSCL 7/3

A new recycle circuit for Gel Permeation Chromatography (GPC), named alternate pumping (AP), is described and applied to the fractionation of epoxy resins. Conceptual as well as design details for AP recycle are presented. Advantages and limitations of AP recycle as compared with conventional recycle are discussed in detail. A calibration curve together with the molecular weight spectra of four competitive commercial epoxy resins are used to demonstrate that greatly improved resolution of oligomers into individual peaks is possible with recycle GPC. Author (GRA)

N71-22081# McGill Univ., Montreal (Quebec).

VISCOELASTIC AND THERMAL PROPERTIES OF INORGANIC POLYMERS AND RELATED MATERIALS Final Report, 1 Sep. 1963–30 Sep. 1970

A. Eisenberg Dec. 1970 14 p refs

(Contracts Nonr-233(87); N00014-68-C-0237)

(AD-717364) Avail: NTIS CSCL 7/4

The results of the research reported can conveniently be divided into five groups. The first deals with the inorganic ionic polymers, while the second describes the work on non-ionic inorganic polymers. The third part is devoted to some studies related to both of the above fields. The fourth part describes work on other non-crystalline materials which grew out of the preceeding studies, and finally, the last part lists two efforts of a supplemental nature. Author (GRA)

N71-22082# Picatinny Arsenal, Dover, N.J.

USE OF A REACTION RATE METHOD TO PREDICT FAILURE TIMES OF ADHESIVE BONDS AT CONSTANT STRESS

Elise McAbee and David W. Levi Dec. 1970 28 p refs

(AD-717554; PA-TR-4105) Avail: NTIS CSCL 11/1

A reaction rate method was successfully used to predict failure times for adhesive bonds under constant stress at 90-95% and at 50% relative humidity. The method was found to be not very useful when the experiments were performed at 20% relative humidity. The results suggest that the method should be particularly useful under high humidity, bond degrading conditions such as exist in the tropics. Author (GRA)

N71-22228# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.

PHASE SEPARATION IN GeO-GeO2 GLASSES Interim Technical Report

J. P. de Neufville and D. Turnbull Dec. 1970 30 p refs

(Contract N00014-67-A-0298-0009)

(AD-717332; TR-31) Avail: NTIS CSCL 11/2

A series of transparent homogeneous amorphous solids between GeO2 and GeO has been prepared by rapid quenching of liquids and by vapour depositions. Density and refractive index increase smoothly with increasing Ge/O ratio and provide a useful index of composition. Glasses in the range GeO-GeO(1.85) undergo a rapid exothermic transformation when heated above 400C accompanied by a pronounced blackening, an increase in refractive index, and a light decrease in density. Electron microscopy and diffraction results indicate that the transformation involves the precipitation on a 50-100 A scale of an amorphous tetrahedrally coordinated Ge-rich phase. The interconnected microstructure so

produced is suggestive of spinodal decomposition. A transitional region near GeO(1.9) is characterized by sluggish phase separation kinetics and a dispersed particle morphology suggestive of a nucleation and growth precipitation mechanism. Glasses in the range GeO(1.9)-GeO2 show no evidence for phase separation. Author (GRA)

N71-22271# Oak Ridge National Lab., Tenn.
EVALUATION OF BURGESS FOBES PAINT COMPANY PROTECTIVE COATINGS FOR NUCLEAR PLANT APPLICATION
T. H. Row and J. C. Griess Jan. 1971 23 p refs
(Contract W-7405-eng-26)
(ORNL-TM-3104) Avail: NTIS

Protective coatings on steel coupons supplied by the Burgess Fobes Paint Company were tested in a spray test loop facility. Coupons coated with the various protective coatings were exposed to a solution containing 2960 ppM boron with a pH of 9.5 under conditions that simulated the temperature and pressure transients of a design-basis accident. There were no observable failures of a number of the coatings, but those with a zinc-rich primer indicate the need for additional investigation because of their high failure rate. Author (NSA)

N71-22276# Air Force Weapons Lab., Kirtland AFB, N.Mex.
ELECTRON FLUORESCENCE IN SOME POLYMERIC SOLIDS Technical Report, Nov. 1968 - Jan. 1969
David C. Straw and Daniel N. Payton, III Jan. 1971 31 p refs
(AD-717709; AFWL-TR-69-99) Avail: NTIS CSCL 7/4

The fluorescence of several polymeric solids exposed to short, intense pulses of electrons has been investigated. Nylon, polytetrafluorethylene, and polyethylene have been studied by using high-speed streak photography. The streak photograph yields a spatial and temporal record of the energy absorption profile. Total base lifetimes of the strong fluorescence varied from 42 to 50 x 10 to the -9th second corresponding closely to the pulse width of the incident electron beam. A typical decay curve for these materials is displayed showing time constants as short as 10 to the -8th second. A spatially narrow region of strong fluorescence which appears near the incident surface of the sample has been identified as being excited by primary electron absorption. The depth of this primary electron absorption is dependent upon the energy profile of the incident electron beam and the detailed buildup of space charge effects. Author (GRA)

N71-22344 Ohio State Univ., Columbus.
AN INVESTIGATION OF THE INFLUENCES OF THERMAL TREATMENTS ON THE DIELECTRIC PROPERTIES OF LITHIA-ALUMINA-SILICA GLASSES
Larry Jay Zook (Ph.D. Thesis) 1969 143 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 70-8928

The structural details of six different glass compositions in the lithia-alumina-silica ternary phase diagram were investigated using ac and dc electrical measurements in the audio and radio frequency ranges as well as X-ray and electron microscopy techniques. The ac data taken from polished disk specimens were presented in graphical form as the dissipation factor plotted as a function of the logarithm of the measurement frequency. Activation energies for relaxation processes were calculated from the temperature dependence of frequencies corresponding to maxima in the parameter tan ac. The dc data consisted of graphs of the logarithm of the dc resistivity versus the reciprocal of absolute temperature from which the activation energies for dc conduction were calculated. These data were analyzed using the Maxwell-Wagner-Sillars theories pertaining to inhomogeneous dielectrics. Dissert. Abstr.

N71-22348# Southwest Research Inst., San Antonio, Tex.
DEVELOPMENT OF NONDESTRUCTIVE TESTING TECHNIQUES FOR DETECTING STRESS IN FERROMAGNETIC MATERIALS Final Report
C. G. Gardner, G. A. Matzkanin, and D. L. Davidson 15 Sep. 1970 51 p refs
(Contract N00156-69-C-0856; ARPA Order 1247)
(AD-717669) Avail: NTIS CSCL 13/8

The major part of the effort of Phase 2 was devoted to perfecting the apparatus and experimental technique required to perform photometric and cinematographic studies of dynamical magnetic domain processes as revealed by the longitudinal Kerr magnetooptic effect. In addition to the magnetooptic effort, progress was made in using the inductive coil approach to study the Barkhausen effect. In particular, cylindrical specimens of polycrystalline silicon-iron suitable for use in the (previously designed and fabricated) nonmagnetic uniaxial stress fixture were designed and fabricated. GRA

N71-22349# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE POSSIBILITY OF ACHIEVING HIGH STRENGTH WITH WHISKERS
S. Z. Bokshtein et al 16 Nov. 1970 25 p refs Transl. into ENGLISH from Proc. of 21st Nauchnaya Sessiya po Probl. Zharoprochnykh Splavov, Fiz.-Khim. Issled. Zharoprochnykh Splavov (Moscow), 1968 p 75-87
(AD-717819; FTD-HT-23-564-70) Avail: NTIS CSCL 11/4

The report discusses the feasibility of achieving high strength in metals and nonmetallic materials by means of reinforcement with whiskers. Also discussed are some problems of the theory of strengthening of composite materials by means of discrete whiskers and some technological problems associated with production of whisker-reinforced composite materials. A detailed analysis is presented, based on Soviet and foreign literature data, of the mechanical properties of metallic and nonmetallic whiskers, of the size effect, of the stress-strain diagrams, of the effect of alloying, and of high-temperature properties. On the basis of an analysis of the above properties, it is concluded that reinforcement of metallic and nonmetallic matrices with whiskers is a quite feasible and very promising method of strengthening metals and alloys, although some complex technological problems are still unsolved. Insofar as they have the best mechanical properties, sapphire, silicon-carbide and aluminum-nitride whiskers are the most promising materials for reinforcement of metals and for obtaining high-strength composite materials. Author (GRA)

N71-22353# Air Force Cambridge Research Labs., Bedford, Mass.
PREPARATION AND ELECTRICAL PROPERTIES OF SOME CERAMIC MATERIALS AT MICROWAVE FREQUENCIES
Martin E. Stiglitz 7 Dec. 1970 17 p refs
(AD-717686; AFCRL-70-0726; AFCRL-PSRP-438) Avail: NTIS CSCL 11/2

The need for high-dielectric constant, low-loss, temperature-stable ceramic materials for microwave-device application has given impetus to the study of various titanate and oxide mixtures. In the course of this research we have developed a material which has a temperature frequency coefficient of 530 ppm/deg C and a dielectric constant of 106, comparable to the American Lava T-96 Ceramic, but has a higher dielectric constant. Methods for mixing, firing, and aging of ceramic materials, as well as microwave measurement techniques, are presented and results are given in graphic form and tables. These results may be valuable to workers wishing to pursue the development of zero temperature coefficient materials further. Author (GRA)

N71-22475# Union Carbide Corp., Oak Ridge, Tenn.
OBSERVATION OF ABLATION BEHAVIOR OF FIBROUS

CARBON CARBON COMPOSITES
J. L. Cook and J. D. Theis 4 Jan. 1971 165 p refs
(Contract W-7405-eng-26)
(Y-1752) Avail: NTIS

Fibrous carbon-carbon composites which were fabricated by filament winding, felting, and spray lay up, and densified by chemical vapor deposition and liquid resin impregnation were ablation tested using a high-pressure arc jet. Behavior of the composites was examined, and the material characteristics were studied by electron and optical microscopy, radiography, porosimetry, X-ray diffractometry, electrical resistivity, and thermal expansivity. Heat-of-ablation values ranged from 12,000 to 27,500 Btu/lb, and behavior varied from uniform, smooth recession to brittle fracturing of thermal-shock-sensitive composites. Author

N71-22488# Illinois Univ., Urbana.
THE EFFECT OF PRESSURE ON THE ELECTRONIC STRUCTURE OF FERRIC HYDROXAMATES AND FERRICHROME A
D. C. Grenoble and H. G. Drickamer [1970] 23 p refs Submitted for publication
(Contract AT(11-1)-1198)
(COO-1198-777) Avail: NTIS

The effect of pressure on the electronic structure of three ferric hydroxamates and on ferrichrome A was studied to 175 kilobars, using optical absorption and Mossbauer resonance. The ferric ion reduced to ferrous ion with pressure as was previously observed for a variety of compounds. For the hydroxamates, the amount of reduction correlated very well with the location and shift of the metal to ligand charge transfer peak, which is consistent with the theory previously presented. The results for ferrichrome A did not fit quantitatively into the series. Since the shape of the potential well is almost certainly different for this compound, this result is not surprising. Author

N71-22498# Stanford Research Inst., Menlo Park, Calif.
THALLIUM IODINE PHASE DIAGRAM
Daniel Cubicciotti 15 Dec. 1970 17 p refs
(Contract AT(04-3)-106)
(SRIA-106-76) Avail: NTIS

The melting point-composition diagram for the thallium-iodine system was determined. From Tl to TlI the solids and liquids are immiscible. From TlI to I2 there is one liquid phase. Solid Tl3I4 melts incongruently at 260 C to a liquid (atom fraction iodine = 0.77) and solid TlI. Solid TlI3 melts incongruently at 129 C to a liquid (atom fraction iodine = 0.84) and solid Tl3I4. A eutectic occurs with liquid (atom fraction iodine = 0.88), solid TlI3, and solid I2 at 90 C. The X-ray powder patterns of Tl3I4 and TlI3 are reported. Author

N71-22559*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Propulsion Div.
FATIGUE OF TEFLON BLADDER BAG MATERIALS
E. F. Cuddihy *In its* JPL Quarterly Tech. Rev., Vol. 1, No. 1 Apr. 1971 p 57-63 refs (See N71-22551 11-30
Copyright. Avail: NTIS HC$6.00/MF$0.95 CSCL 11D

A correlation between fatigue and stress-strain behavior of Teflon materials was observed during a study of the fatigue properties of liquid propellant expulsion Teflon bladder bag materials. This correlation requires only the knowledge of the ultimate breaking stress of the materials in order to obtain an estimate of the fatigue properties, and permits a rapid assessment of the expected fatigue behavior of candidate materials for bladder bags from only a comparison of their ultimate breaking stress. The general principles of this method of fatigue analysis are discussed, along with the recognition that this technique should have general application for other polymeric materials where stress-strain behavior is comparable to Teflon. Author

N71-22581# Cornell Univ., Ithaca, N.Y. Materials Science Center.
ULTRASONIC MEASUREMENTS ON PARAELASTIC IMPURITIES IN ALKALI HALIDES
Henry E. Shuman (Ph.D. Thesis) Jan. 1971 86 p refs Sponsored by AEC
(NYO-2471-47; Rept-1469) Avail: NTIS

Changes in the complex compliance due to Li(+), CN(-), OH(-) impurities in KCL and CN(-) in RbCl were measured in the temperature range .34 K to 77 K. The dependence of the KCl:Li(+) compliance change on uniaxial stress was also investigated. The ultrasonic measurements were made by a pulse echo, and pulse interference technique in the frequency range 10-90 MHz. The tunneling model for off-center impurities of Gomez, Bowen, and Krumhansl was expanded to include a paraelastic interaction term in the defect Hamiltonian. The observed temperature and uniaxial stress dependence of the KCl:Li(+) compliance change was found to agree with the predictions of this model. The energy level splitting, the basis state overlap integral, and the paraelastic interaction strength were evaluated and agreed, except for a concentration dependence, with previous measurements. The results for the molecular impurities do not agree with either the GBK or the Devonshire models. Measurements of KCl:OH(-), and KCl:CN(-) indicate that neither is a <100> elastic impurity; RbCl:CN(-) is probably a <111> elastic defect. Author

N71-22665 National Lending Library for Science and Technology, Boston Spa (England).
INVESTIGATION OF THE VAPORISATION OF URANIUM CARBIDE, NITRIDE AND CARBONITRIDES
R. A. Andrievskii et al 1 Jun. 1970 14 p refs Transl. into ENGLISH from Atomnaya Energ. (Moscow), v. 26, no. 6, Jun. 1969 p 494-498 In ENGLISH and RUSSIAN
(NLL-Windscale-410-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The differential Knudsen method was changed to an integrating method to increase the accuracy of uranium vapor pressure measurements. Results indicate that an increase in carbon and monocarbide content leads to a decrease in the vapor pressure of uranium, and a change from carbide to nitride leads to an increase in pressure. Small amounts of oxygen and nitrogen dissolved in uranium carbide lead only to a possible change in the deviation from stoichiometry, and the systems UC-UN and UC-UO are close to ideal. Remaining discrepancies between experimental values are discussed. N.E.N.

N71-22892 Pennsylvania State Univ., University Park.
STUDIES OF THE DIVALENT RARE EARTH OXIDES
Gregory Joseph McCarthy (Ph.D. Thesis) 1969 105 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 70-7231

Direct preparation of the rare earth monoxide by reduction of the sesquioxide with the corresponding rare earth metal was attempted. Europium monoxide was easily prepared by this method, but samarium and ytterbium monoxides could not be prepared. The phase relations in a 1400 C isotherm of the systems Eu-Ti-O, Sm-Ti-O and Yb-Ti-O were investigated. In the system Eu-Ti-O the following ternary phases were prepared: Eu2TiO5, Eu2Ti2O7, Eu2TiO4, Eu3Ti2O7, Eu4Ti3O10, (EuTiO3)SS and EuTi12O19. In the latter five phases the europium was found to be divalent. Only trivalent rare earth ternary phases were found in the systems Sm-Ti-O and Yb-Ti-O. Substitutions of Sm3(+) Ti3(+) O3 into Sr2(+) Ti4(+) O3 failed to stabilize even a small amount of Sm2(+). Efforts to reproduce the previously reported preparations of divalent samarium and ytterbium silicates were also unsuccessful. All these experiments confirmed the hypothesis that single and mixed oxides of divalent samarium and ytterbium are unstable at low and moderate temperatures. Author

N71-22883 Pennsylvania State Univ., University Park.
MELTING HISTORY EFFECTS ON THE STRENGTH OF LITHIUM-POTASSIUM AND LITHIUM-SODIUM SILICATE GLASS SYSTEMS
Ronald Van Caporali (Ph.D. Thesis) 1969 183 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 70-7189

0.5Li2O-0.5K2O-2.0SiO2 was studied in great detail concerning the effect of melting parameters such as the melting time, melting temperature, size of melt, and stirring versus non-stirring, on the resulting glass strengths. In order to separate surface effects from bulk effects the strengths measured under the following conditions were compared: (1) As-drawn pristine glass rods were tested in liquid nitrogen, air and water. (2) Annealed pristine glass rods were tested in liquid nitrogen. (3) As-drawn glass rods were tested in liquid nitrogen after they had been given an HF acid etch treatment or a uniform controlled abrasion. Explanations for the causes of the melting history effect on strength were sought by analyses for changes in the chemical composition, variations in nitrogen and water contents, and platinum pickup as a function of melting time, and by measurements of Young's Modulus and electron microscopic investigations. Dissert. Abstr.

N71-22894* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
METHOD FOR PRODUCING FIBER REINFORCED METALLIC COMPOSITES Patent
John W. Weeton, Max Quatinetz, and Robert W. Jech, inventors (to NASA) Issued 22 Aug. 1967 (Filed 16 Dec. 1965) 4 p Cl. 75-204
(NASA-Case-XLE-03925; US-Patent-3,337,337; US-Patent-Appl-SN-514407) Avail: US Patent Office CSCL 11D

A procedure for producing metallic composites reinforced with ceramic and refractory hard metals that are fibered in place is described. The fibering is accomplished by embedding equiaxed additives in a matrix and elongating these additives into fibers by extrusion, swaging, and rolling. The additives are deformable at temperatures which are lower than the melting point of the matrix.
Official Gazette of the U.S. Patent Office

N71-22998* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
FOAMED IN PLACE CERAMIC REFRACTORY INSULATING MATERIAL Patent
Alfred G. Eubanks and Ronald E. Hunkeler, inventors (to NASA) Issued 7 May 1968 (Filed 28 Aug. 1964) 6 p Cl. 106-40
(NASA-Case-XGS-02435; US-Patent-3,382,082; US-Patent-Appl-SN-392965) Avail: US Patent Office CSCL 11D

Foamed-in-place ceramic refractory composition is discussed. The composition comprises the following ingredients: (1) powdered aluminum hydroxide, (2) phosphoric acid, (3) bentonite, (4) powdered aluminum phosphate, and (5) a metal powder above hydrogen in the electrochemical series. It also can include powdered silicon dioxide. In the process all specified quantities of the above named ingredients, except for the phosphoric acid, are thoroughly mixed. Then the phosphoric acid is added and the total mixture stirred until a slurry is formed. The slurry is poured into a container which houses an object to be potted or not as the case may be and the slurry is allowed to stand until it has foamed sufficiently to fill the container. Finally, the container is placed in an oven and the foamed slurry is cured at the relatively low temperatures of from 65 to 100 degrees centigrade.
Official Gazette of the U.S. Patent Office

N71-23010 California Univ., Berkeley.
MECHANICAL PROPERTIES AND FRACTURE BEHAVIOR OF CHEMICALLY BONDED COMPOSITES
Mark Alexander Stett (Ph.D. Thesis) 1969 56 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 70-8232

The effect of chemical bonding between phases of a glass-metal composite on the strength and fracture behavior was investigated. When no chemical bonding occurs, strengthening can be achieved through the mechanical formation of an interface between dispersant and matrix. By the formation of a chemical bond, an even greater strengthening can be obtained. Strengthening occurs by the limitation of the Griffith flaw size and is controlled by micromechanical stress concentrations developed upon loading. Internal stresses developed upon cooling from the fabrication temperature control the path of fracture. The existence of a chemical bond serves to counteract the micromechanical stress concentration and therefore increase the strength. Dissert. Abstr.

N71-23011 Pennsylvania State Univ., University Park.
CRYSTAL CHEMISTRY, PHASE EQUILIBRIA AND PROPERTIES OF TERNARY LEAD-OXYGEN SYSTEMS
Kenneth Lee Keester (Ph.D. Thesis) 1969 180 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 70-7215

New oxides were characterized by X-ray diffraction, optical microscopy, electron microscopy and diffraction, electron microprobe analysis, and spectroscopic measurements. Subsolidus phase equilibria studies were used to determine the total number of compounds in the system. Oxygen pressure versus temperature diagrams serve to illustrate the thermodynamic stability and compatibility relations to the new oxides. Selected property measurements and property characterization were made for these new oxides. Electronic spectra from diffuse reflectance measurements were used to determine optical band gaps for the ternary oxides and the binary lead oxides as well. Factor group analyses of the known structure types predicts vibronic spectra. Measured spectra indicated PbO [Litharge], PbO [Massicot] and Sr2PbO4 have potential as infrared transmitting materials. None of the ternary oxides are strong photoconductive materials. Dissert. Abstr.

N71-23044 Texas A&M Univ., College Station.
AN ENERGY BALANCE METHOD OF FRACTURE PREDICTION IN ELASTOMERS AND ELASTOMERIC COMPOSITES
Leonard Dale Webb (Ph.D. Thesis) 1969 163 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 70-9729

A unifying approach to failure prediction in elastomers based upon principles of fracture mechanics is proposed and experimentally evaluated. The experiments described confirm the existence of characteristic strain energy release rate for cracks propagating through elastomers. The analytics illustrate the use of the numerical stiffness programs to compute the total strain energy in various geometries with different crack lengths and locations. Taken together, the growth of both cohesive cracks in an elastomer and adhesive cracks along an interface can be predicted. The principal loading condition considered was thermal where the strain energy was accumulated due to restrained thermal shrinkage in the fracturing of solid propellants. The results indicate that the energy balance method is useful both for predicting the onset of cracking and for adjusting design parameters to minimize the tendency for fracturing to occur. Dissert. Abstr.

N71-23045 Purdue Univ., Lafayette, Ind.
A RADIOMETRIC INVESTIGATION OF EMISSIVITIES AND EMITTANCES OF SELECTED MATERIALS AT CRYOGENIC TEMPERATURES
Keith Harold Hawks (Ph.D. Thesis) 1969 256 p
Avail: Univ. Microfilms: HC $11.70/Microfilm $3.30 Order No. 70-8901

An experimental technique for the radiometric measurement of emittances at cryogenic temperatures is defined, discussed and demonstrated. The technique consists of measuring the irradiation from a blackbody and a specimen as a function of the specimen temperature with a gallium-doped germanium bolometer. After the appropriate corrections are made to the irradiation data, the experimental emittances are obtained by taking the ratio of the measurements at the same temperature. Experimental results for a cylindrical cavity blackbody, a copper substrate painted with 3M black velvet paint, a copper specimen, an aluminum specimen, and a stainless steel specimen are presented. The specimen temperature range is 100 to 5 K. The results are compared with other experimental emittances. The emissivities of copper and aluminum calculated from the quantum mechanical and anomalous skin effect theory are also given. Dissert. Abstr.

N71-23047* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THERMAL CONTROL COATING Patent
Noel T. Wakelyn, inventor (to (NASA) Issued 30 Jul. 1968 (Filed 17 Nov. 1964) 5 p Cl. 148-6.16
(NASA-Case-XLA-01995; US-Patent-3,395,053; US-Patent-Appl-SN-411945) Avail: US Patent Office CSCL 11C

A method is described for improving the optical and thermal control property characteristics of an aluminum surface having a metal phosphate protective coating. The surface coating is subjected to a controlled temperature low concentration alkaline solution for a controlled period of time to improve the chemical bond between the coating and the substrate and to reduce the coating weight. Official Gazette of the U.S. Patent Office

N71-23088* Hughes Aircraft Co., Culver City, Calif.
METHOD FOR FIBERIZING CERAMIC MATERIALS Patent
Louis E. Gates, Jr. and William E. Lent, inventors (to NASA) Issued 22 Aug. 1967 (Filed 10 Nov. 1964) 4 p Cl. 65-7 Sponsored by NASA
(NASA-Case-XNP-00597; US-Patent-3,337,315; US-Patent-Appl-SN-410325) Avail: US Patent Office CSCL 11B

A five step process for fiberizing ceramic materials having relatively high fusion temperatures and tensile strengths is discussed. The ceramic materials, suitable to be fiberized by the process, are uniquely formulated to provide for relatively high fusion temperatures and tensile strengths. When properly treated by the process, the materials provide a relatively high yield of glass fibers which may be converted into fabrics or rigid structural components which are remarkably resistant to heat.
Official Gazette of the U.S. Patent Office

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see specific categories. For related information see also: 08 Computers.

N71-21901# Joint Publications Research Service, Washington, D.C.
SUPERINTUITIONIST LOGIC AND THE SITING PROBLEM
12 Mar. 1971 18 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 195, no. 5, 1970 p 1029–1032; no. 6, 1970 p 1294–1295; v. 196, no. 1, 1971 p 16–19
(JPRS-52599) Avail: NTIS

CONTENTS:
1. SUPERINTUITIONIST LOGICS AND FINITE APPROXIMATIBILITY A. V. Kuznetsov et al p 1–7 refs (See N71-21902 11-19)
2. NEW APPROACH TO THE SITING PROBLEM Yu. L. Ziman p 8–10 refs (See N71-21903 11-19)
3. AUTOMATIC AND ZONAL COMPLEXITY OF THE PREDICATE TO THE K-TH POWER OF A NUMBER Yu. Ya. Breytbart p 11–16 refs (See N71-21904 11-19)

N71-21902# Joint Publications Research Service, Washington, D.C.
SUPERINTUITIONIST LOGICS AND FINITE APPROXIMABILITY
A. V. Kuznetsov et al *In its* Superintutitionist Logic and the Siting Probl. 12 Mar. 1971 p 1–7 refs (See N71-21901 11-19)
Avail: NTIS

A refutation is presented of the hypothesis on the finite approximatibility of superintuitionist calculus of propositions. The hypothesis associated with the question of whether an algorithm that affords recognition of formula validity in a given logic exists for each logic. The proof is based on the analysis of the example of a formula that is prevalid in an infinite compact algebra. N.E.N.

N71-21903# Joint Publications Research Service, Washington, D.C.
NEW APPROACH TO THE SITING PROBLEM
Yu. L. Ziman *In its* Superintuitionist Logic and the Siting Probl. 12 Mar. 1971 p 8–10 refs (See N71-21901 11-19)
Avail: NTIS

The problem of siting production units is considered which gives the number of objects n that must be located in n' > or = n possible locations. A general formulation of the problem is given in which the subsets of the set of elements N are connected with each other in the form of a tree so that if the order of the link is p, there exists p to the (p – 2) power different ways of executing the connections the link. The problem is then formulated in terms of regular imbedding. N.E.N.

N71-21904# Joint Publications Research Service, Washington, D.C.
AUTOMATIC AND ZONAL COMPLEXITY OF THE PREDICATE TO THE k-th POWER OF A NUMBER
Yu. Ya. Breytbart *In its* Superintuitionist Logic and the Siting Probl. 12 Mar. 1971 p 11–16 refs (See N71-21901 11-19)
Avail: NTIS

Let Sigma = 0,1,...,(p – 1), where p is a prime number. The set Sigma* of words in the alphabet is considered such that each word, except an empty word, is regarded as the p-ary notation of some natural number. The predicate T sub k (x) is defined for the set Sigma* for any k > or = 2. It is proven that any finite automaton recognizing T sub k (x) in words of length not exceeding n requires an order of states not less than p to the n/k power. As a consequence, an estimate of the on-line zone of the Turing machine recognizing the predicate T sub k (x) will be obtained, where in the first case the estimate is final in respect to order. Author

N71-21982*# Israel Program for Scientific Translations, Ltd., Jerusalem.
THEORY OF BIFURCATIONS OF DYNAMIC SYSTEMS ON A PLANE
A. A. Andronov et al 1971 497 p refs Transl. into ENGLISH of the publ. 'Teoriya Bifurkatsii Dinamicheskikh Sistem Na Ploskosti' Moscow, Nauka, 1967 Supported by NASA and NSF
(NASA-TT-F-556; TT-69-55019) Copyright. Avail: NTIS HC $6.00/MF $0.95 CSCL 12A

The changes in the topological structure of a dynamic system when the system itself changes were studied in structurally stable systems. The application of the theory of bifurcations, which is

concerned with changes in the topological structure of dynamic systems led to an examination of the unstable systems. Techniques were developed for the investigation of particular differential equations, and the creation of limit cycles from closed paths of conservative systems is discussed. F.O.S.

N71-22020 Northwestern Univ., Evanston, Ill.
CONSTRAINED MAXIMIZATION OF POSYNOMIALS AND VECTOR-VALUED CRITERIA IN GEOMETRIC PROGRAMMING
Lois de la Cruz Pascual (Ph.D. Thesis) 1969 70 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 70-6516

An extension of geometric programming is given which is geared to the solution of two classes of engineering design problems. The first class of problems is that of a constrained maximization of posynomials. The exponents are arbitrary real numbers, but the coefficients are assumed to be positive. The second class of problems is the determination of efficient points for a constrained minimization problem with multiple criteria, which may be in conflict. The solution proposed here is based on condensing posynomials to monomial forms, an idea used by Duffin to linearize geometric programs. Applications to optimum design problems hitherto solved by graphical and other methods are given, which continue the works of Zener, Duffin, Peterson, Wilde, Avriel, Passy and others in the application of geometric programming to engineering. Dissert. Abstr.

N71-22176*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ANALYSIS OF A TWO-DIMENSIONAL MASS TRANSPORT PROBLEM IN CONTAMINATION OF SPACE FLIGHT EXPERIMENTS
Edwin Klingman 18 Feb. 1971 40 p refs
(NASA-TM-X-64581) Avail: NTIS CSCL 12A

The two-dimensional mass transport problem in a box with sinks and sources is analyzed both analytically and numerically. The results are compared and found to be in good agreement. The basis is thus laid for a three-dimensional numerical (Monte Carlo) mass transport program for use in analysis of space flight contamination experiments. Author

N71-22177*# Arizona Univ., Tucson. Dept. of Electrical Engineering.
USE OF COMPLEX OPTIMIZATION FOR SENSITIVITY DETERMINATION IN DISTRIBUTED LUMPED ACTIVE NETWORKS
L. P. Huelsman [1971] 6 p
(Grant NGL-03-002-136)
(NASA-CR-117757) Avail: NTIS CSCL 12A

A method of applying complex optimization techniques to determine various sensitivity coefficients for distributed-lumped-active networks is presented. Author

N71-22267# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France)
MASS SHIFTS IN SECOND ORDER OF PERTURBANCE THEORY IN THE DUAL RESONANCE MODEL
J. Scherk (Ph.D. Thesis—Paris Univ.) Feb. 1971 11 p refs
(LPTHE-71/7) Avail: NTIS

It is shown that in the Virasoro case of unit intercept, the divergent part at order g(2) of the mass matrix of the physical states is simply proportional to the unit matrix. Therefore it is possible in this case to compute all mass shifts at order g(2) up to a single subtraction constant. Author

N71-22268# Lockheed Missiles and Space Co., Palo Alto, Calif.
DYNAMICS OF AN ORIENTATION SYSTEM WITH SPATIAL LEAD
E. V. Gaushus et al 1970 3 p refs Transl. into ENGLISH from Kosm. Issled. (USSR), v. 8, no. 6, 1970 p 939–941
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

A method of assuring prolonged space vehicle orientation is considered. It is assumed that the orientation transducer has a relay characteristic with spatial lead (hysteresis). Such a transducer permits assurance of attenuation of space vehicle oscillations during the transient, and maintenance of a stable orientation in the steady state oscillations mode. Author

N71-22408*# Brown Univ., Providence, R.I. Center for Dynamical Systems.
ON DIFFUSIONS WITH DISCONTINUOUS DRIFT TERMS: EXISTENCE, UNIQUENESS, STABILITY AND APPROXIMATIONS
Harold J. Kushner Jan. 1971 53 p refs
(Grants NGL-40-002-015; AF-AFOSR-0693-67B; NSF GK-2788)
(NASA-CR-117746; AD-716581; DOS-TR-71-1; AFOSR-70-2832TR) Avail: NTIS CSCL 12A

CONTENTS:

1. APPROXIMATIONS TO AND LOCAL PROPERTIES OF DIFFUSIONS WITH DISCONTINUOUS CONTROLS H. J. Kushner 27 p refs (See N71-22409 11-19)

2. STABILITY AND EXISTENCE OF DIFFUSIONS WITH DISCONTINUOUS OR RAPIDLY GROWING DRIFT TERMS H. J. Kushner 23 p refs (See N71-22410 11-19)

N71-22409*# Brown Univ., Providence, R.I. Center for Dynamical Systems.
APPROXIMATIONS TO AND LOCAL PROPERTIES OF DIFFUSIONS WITH DISCONTINUOUS CONTROLS
Harold J. Kushner *In its* On Diffusions with Discontinuous Drift Terms Jan. 1971 refs 27 p (See N71-22408 11-19)
Avail: NTIS CSCL 12A

The stochastic differential (Ito) equation, $dx = f(x,t,u(x,t))dt + \sigma(x,t)dz$, is a common model of a variety of stochastic control systems. It is shown that, under reasonable conditions, the process constructed previously is a very natural solution to the equation, whether or not it is the unique solution, since it is the limit of the discrete time approximation, in the sense that the multivariate distributions converge. Uniqueness is then shown. The possibly discontinuous u is replaced by a sequence which converges to u pointwise except on the set of discontinuity of u, and it is proved that the costs of control converge to the cost for discontinuous controls. Finally, it is shown that the local and growth properties of the equation are of the same type as the Lipschitz u. The control u is fixed. Author

N71-22410*# Brown Univ., Providence, R.I. Center for Dynamical Systems.
STABILITY AND EXISTENCE OF DIFFUSIONS WITH DISCONTINUOUS OR RAPIDLY GROWING DRIFT TERMS
Harold J. Kushner *In its* On Diffusions with Discontinuous Drift Terms Jan. 1971 refs 23 p (See N71-22408 11-19)
Avail: NTIS CSCL 12A

Stochastic differential equations whose drift terms do not satisfy the usual (Ito) Lipschitz or linear growth conditions in the state occur frequently as models in stochastic control theory. Local stability properties are useful for proving global existence for ordinary differential equations whose right hand sides grow too fast or are not Lipschitz in the state. Here, a local stochastic stability

property is used to prove global existence, stability, ergodicity, the strong Markov and other properties, for a class of diffusions which occur frequently as models. Author

N71-22463# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
HARMONIC ANALYSIS ON THE POINCARE GROUP. 2: THE FOURIER TRANSFORM
Nghiem Xuan Hai Feb. 1971 30 p refs
(LPTHE-71/4) Avail: NTIS

The generalized matrix elements on the Poincare group are used to write the Fourier transform explicitly. This realizes a mapping between positive type functions on the group and generalized density matrices. Author

N71-22497# Technion-Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.
SOLVING BOUNDARY VALUE PROBLEMS BY IMBEDDING
E. Wesserstrom Apr. 1970 27 p refs
(TAE-112) Avail: NTIS

Boundary value problems of nonlinear ordinary differential equations are reformulated as a rather complicated initial value problem, whose solution is more adaptable to numerical computation by computers. Several examples are solved. The advantages and drawbacks of the method are briefly discussed. Author

N71-22553*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Space Sciences Div.
APPLICATIONS OF FORMAC IN THE MATHEMATICS OF GENERAL RELATIVITY
H. D. Wahlquist *In its* JPL Quarterly Tech. Rev., Vol. 1, no. 1 Apr. 1971 p 13–16 refs (See N71-22551 11-30)
Copyright. Avail: NTIS HC $6.00/MF $0.95 CSCL 12A

The use of FORMAC (formula manipulation by computer) to perform symbolic analysis on the computer in the field of general relativity is described. FORMAC will accept symbolic analytical expressions involving complex algebraic functions, elementary transcendental functions, user-defined functions, and unspecified functions of any number of dependent variables. In particular, FORMAC programs have now been written to implement the noncommutative calculus of exterior differential forms. Applications of this new capability to Hamiltonian cosmology and the theory of partial differential equations are discussed. Author

N71-23013 Purdue Univ., Lafayette, Ind.
A METHOD FOR GENERATING LYAPUNOV FUNCTIONS EMPLOYING FREQUENCY DOMAIN CONCEPTS
Joseph E. Kalinowski (Ph.D. Thesis) 1969 172 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 70-8911

A method of constructing Lyapunov functions for nonlinear, autonomous, continuous-time systems is derived. Entitled the combined time frequency domain (CTFD) method, it is based upon a method of generating Lyapunov functions developed by R. W. Brockett. While the straight forwardness of the Brockett approach is retained, the restrictions on the form of the nonlinearity, which limit the utility of the Brockett method, are unnecessary in the CTFD method. Consequently, the CTFD method can be applied in the stability analysis of systems which possess a finite region of asymptotic stability as well as those which are asymptotically stable in the large (ASIL). Only certain classes of systems of the latter type can be examined using the Brockett method. A number of examples from the control and nuclear engineering literature are analyzed using the CTFD method in order to compare it with other existing methods of generating Lyapunov functions and to test its utility as a potential design tool. Dissert. Abstr.

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N71-21859# Texas Univ., Austin. Atmospheric Science Group.
GEOSTROPHIC WIND DEVIATION IN THE UPPER TROPOSPHERE AND LOWER STRATOSPHERE IN THE EL PASO-WHITE SANDS AREA
Hsing-Wu Wu Dec. 1970 61 p refs
(Contract DA-29-040-AMC-1802(E))
(AD-717269; Rept-26) Avail: NTIS CSCL 4/2

Wind data at and above the 500-mb level taken from the El Paso rawinsonde station, and pressure-height data at the same levels from Albuquerque, Midland, Tucson, and Chihuahua during the 1965-66 winter and the 1966 summer periods were used to study geostraphic wind deviation. Geostropic winds were computed directly from the pressure-height data by a finite-difference method and compared to the actual wind as measured at El Paso. The variation of the geostrophic deviation with wind speed and pressure-height was examined. Errors involved were analyzed and the true geostrophic deviation and the total wind accelerations were estimated. Author (GRA)

N71-21940# Air Force Cambridge Research Labs., Bedford, Mass.
A METHOD FOR FILTERING METEOROLOGICAL DATA
Rosemary M. Dyer 15 Oct. 1970 21 p refs
(AD-717656; AFCRL-70-0669; AFCRL-PSRP-435) Avail: NTIS CSCL 4/2

A mathematical filter for eliminating persistence in meteorological data is proposed and discussed. Relationships between statistical parameters of the filtered and the original data are derived, examples of the effect of the filter on the power spectrum of various types of input data are also given. Author (GRA)

N71-21953# Joint Publications Research Service, Washington, D.C.
METEOROLOGY
In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 246 12 Feb. 1971 p 5–23 (See N71-21951 11-30)
Avail: NTIS

Abstracts and bibliographies of meteorological articles are presented. Included are the following topics; seasonal transformation of radiation temperatures and clouds, satellite meteorology, monitoring temperature of underlying surface, and attenuation of monochromatic radiation in surface atmosphere. F.O.S.

N71-22014# Institut Royal Meteorologique de Belgique, Brussels.
CLIMATOLOGICAL OBSERVATIONS Monthly Bulletin, Jan. 1971 [OBSERVATIONS CLIMATOLOGIQUES Bulletin Mensuel, Janvier 1971]
1970 16 p In FRENCH and DUTCH
Avail: NTIS

Meteorological parameters observed at different Belgian weather stations during January 1971 are given. ESRO

N71-22015# Institut Royal Meteorologique de Belgique, Brussels.
ATMOSPHERIC POLLUTION, SMOKE, AND SULFUR DIOXIDE Monthly Bulletin, May 1970 [POLLUTION ATMOSPHERIQUE, FUMEE ET ANHYDRIDE SULFUREUX Bulletin Mensuel, Mai 1970]
1970 28 p In FRENCH and DUTCH Prepared jointly with Inst. d'Hyg. et d'Epidemiol.
Avail: NTIS

Data obtained at Belgian weather stations in May 1970 are tabulated. The air pollution sampling apparatus is briefly described. ESRO

N71-22018# Institut Royal Meteorologique de Belgique, Brussels.
ATMOSPHERIC POLLUTION, SMOKE, AND SULFUR DIOXIDE Monthly Bulletin, Sep. 1970 [POLLUTION ATMOSPHERIQUE, FUMEE ET ANHYDRIDE SULFUREUX Bulletin Mensuel, Septembre 1970]
1970 28 p In FRENCH and DUTCH Prepared jointly with Inst. d'Hyg. et d'Epidemiol.
Avail: NTIS

Data obtained at Belgian weather stations in September 1970 are tabulated. The air pollution sampling apparatus is briefly described. ESRO

N71-22017# Institut Royal Meteorologique de Belgique, Brussels.
ATMOSPHERIC POLLUTION, SMOKE, AND SULFUR DIOXIDE Monthly Bulletin, Jul. 1970 [POLLUTION ATMOSPHERIQUE, FUMEE ET ANHYDRIDE SULFUREUX Bulletin Mensuel, Juillet 1970]
1970 28 p In FRENCH and DUTCH Prepared jointly with Inst. d'Hyg. et d'Epidemiol.
Avail: NTIS

Data obtained at Belgian weather stations in July 1970 are tabulated. The air pollution sampling apparatus is briefly described. ESRO

N71-22051# Joint Publications Research Service, Washington, D.C.
METEOROLOGY
In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 247 1 Mar. 1971 p 9-15 (See N71-22049 11-30)
Avail: NTIS

News releases are presented on spectral instrumentation development for balloon sounding at 30 km in 0.36 to 13 micron wavelengths. Results of a five year test program of a radio warning system for mud flows in Zailiyskiy Alatau Mts. are reviewed. A book review on weather stellite data interpretation is summarized. Abstracts on various meteorological literature are also given, including distribution of cloud droplet sizes, atmospheric parameter over wave covered sea, and angular distribution of long wave outgoing radiation. J.A.M.

N71-22083# Institut Royal Meteorologique de Belgique, Brussels.
ATMOSPHERIC POLLUTION, SMOKE, AND SULFUR DIOXIDE Monthly Bulletin, Jun. 1970 [POLLUTION ATMOSPHERIQUE, FUMEE ET ANHYDRIDE SULFUREUX Bulletin Mensuel, Juin Juin 1970]
1970 28 p In FRENCH and DUTCH Prepared jointly with Inst. d'Hyg. et d'Epidemiol.
Avail: NTIS

Data obtained at Belgian weather stations in June 1970 are tabulated. The air pollution sampling apparatus is briefly described. ESRO

N71-22084# Institut Royal Meteorologique de Belgique, Brussels.
CLIMATOLOGICAL OBSERVATIONS Monthly Bulletin, Dec. 1970 [OBSERVATIONS CLIMATOLOGIQUES Bulletin Mensuel, Decembre 1970]
1970 16 p In FRENCH and DUTCH
Avail: NTIS

Meteorological parameters observed at different Belgian weather stations during December 1970 are given. ESRO

N71-22085# Institut Royal Meteorologique de Belgique, Brussels.
ATMOSPHERIC POLLUTION, SMOKE, AND SULFUR DIOXIDE Monthly Bulletin, Aug. 1970 [POLLUTION ATMOSPHERIQUE, FUMEE ET ANHYDRIDE SULFUREUX Bulletin Mensuel, Aout 1970]
1970 28 p In FRENCH and DUTCH Prepared jointly with Inst. d'Hyg. et d'Epidemiol.
Avail: NTIS

Data obtained at Belgian weather stations in August 1970 are tabulated. The air pollution sampling apparatus is briefly described. ESRO

N71-22263# Israel Program for Scientific Translations, Ltd., Jerusalem.
METEOROLOGY: A HISTORICAL SURVEY, VOLUME 1
Kh. P. Pogosyan, ed. 1970 393 p refs Transl. into ENGLISH of the book 'Ocherki Razvitiya Meteorologii' Leningrad, Gidrometeorol. Izd., 1959 Sponsored by ESSA and NSF 2d edition, revised
(TT-69-55106) Copyright. Avail: NTIS HC $6.00/MF $0.95 CSCL 04B

The historical development of the science of meteorology is described. A general outline is given of the growth of man's ideas about the air envelope of the earth, the atmosphere, and about the phenomena occurring in it. Various study methods and scientific theories are discussed and compared. This volume, Volume 1, takes you from the beginnings of science up to the year 1920. Author

N71-22264+ Japan Meteorological Agency, Tokyo.
AEROLOGICAL DATA OF JAPAN, JANUARY 1970. APPENDIX: ROCKET SONDE DATA
1970 291 p refs
Avail: NTIS

Monthly upper air data observed in Japan and its vicinity are given. The observations made by Japan are obtained according to JMA: guide for method of upper air observation; that is, the data are corrected for temperature error due to solar radiation and the effect of low temperature on the vacuum cell, and the curvature of the surface of the earth is taken into account in the computation of upper winds. Author

N71-22265+ Japan Meteorological Agency, Tokyo.
AEROLOGICAL DATA OF JAPAN, MARCH 1970
1970 291 p refs
Avail: NTIS

Monthly upper air data observed in Japan and its vicinity are reported. The observations made by Japan are obtained according to JMA: guide for method of upper air observation; that is, the data are corrected for temperature error due to solar radiation and the effect of low temperature on the vacuum cell, and the curvature of the surface of the earth is taken into account in the computation of upper winds. Author

N71-22266# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NUMERICAL FORECAST AND ANALYSIS OF METEOROLOGICAL FIELDS: SELECTED ARTICLES
S. A. Mashkovich et al 4 Nov. 1970 129 p refs Transl. into ENGLISH from Gidrometeorol. Nauch.-Issled. Tsentr. SSSR, Tr. (Moscow), no. 19, 1968 p 1-66, 72-84
(AD-717817; FTD-MT-24-174-70) Avail: NTIS CSCL 4/2

The document contains the following reports: Improvement of the methodology of forecasting the baric field for several days; Finite-difference algorithm of a solution of the vorticity equation for the middle troposphere over the northern hemisphere; Numerical solution of the balance equation in the framework of a

quasi-solenoidal forecast diagram of the geopotential for the northern hemisphere; The investigation of heating in the stratosphere using numerical experiments; On the application of the filtration theory of random processes to some problems of objective analysis; On the filtration of fields obtained as a result of nonlinear transformations of the initial values of meteorological factors; and Objective analysis of the geopotential field using supplemental information. GRA

N71-22269# Air Force Global Weather Central, Offutt AFB, Nebraska.

AFGWC AUTOMATED METEOROLOGICAL DATA PROCESSING

Richard K. Wilson 15 Sep. 1970 88 p refs

(AD-717652; AFGWC-TM-70-6) Avail: NTIS CSCL 4/2

The present state of the art in automated meteorological data processing as practiced at Air Force Global Weather Central is discussed. This includes major activities from interface with the Department of Defense operated Automated Weather Network (AWN) to the storage of individual reports into the AFGWC data base prior to scientific validity checks. Only the meteorological data processing or decoding of conventional weather reports is discussed. A description of scientific validation of these reports is not included. Computer storage formats for each type of data are shown. Author (GRA)

N71-22360# Missouri Univ., Rolla. Graduate Center for Cloud Physics Research.

THEORY OF DROPLET GROWTH IN CLOUDS. 2: DIFFUSIONAL INTERACTION BETWEEN TWO GROWING DROPLETS

John C. Carstens, Allen Williams, and Joseph T. Zung Repr. from J. Atmos. Sci., v. 27, no. 5, Aug. 1970 p 798-803 Revised

(Contract N00014-68-A-0497)

(AD-717788) Avail: NTIS CSCL 4/2

The interaction of two growing droplets in a supersaturated atmosphere has been examined, and the temperature and vapor density profiles have been determined. It is found that the smaller droplet tends to catch up with the larger at a slower rate than predicted by conventional diffusion theory. Consideration of droplet fallspeeds leads to the conclusion that, under atmospheric conditions, growth interaction becomes significant only for droplet pairs having equal or nearly equal radii. The number of such pairs is generally small enough so that the effect on the size distribution is quite small. Of a much greater importance is the possibility of a resulting attractive diffusio-phoretic force between two growing drops which, in turn, gives rise to a net velocity of one drop toward the other. If this diffusion force of attraction becomes sufficiently strong to overcome the hydrodynamic and thermo-phoretic forces acting in the opposite direction, both collision efficiencies and coagulation of small droplets could be further enhanced, thus accounting for departures from monodispersity in actual atmospheric clouds. Author (GRA)

N71-22361# Naval Weather Service, Washington, D.C.

SUMMARY OF SYNOPTIC METEOROLOGICAL OBSERVATIONS. NORTH AMERICAN COASTAL MARINE AREAS. VOLUME 12: AREA 4 CORDOVA, AREA 5 SEWARD, AREA 6 KODIAK

Dec. 1970 484 p

(AD-717360) Avail: NTIS HC $6.00/MF $0.95 CSCL 4/2

The data contained in these tables were obtained from tape data Family 11 (TDF-11), Marine Surface observations. TDF-11 was primarily funded by the Naval Weather Service Command and selected by NWSED Asheville as the most comprehensive collection of marine surface observations from which to develop a series of coastal marine summaries. The area includes Cordova, Seward, and Kodiak, Alaska. GRA

N71-22362# National Hurricane Research Lab., Miami, Fla.

PROJECT STORMFURY Annual Report, 1969

May 1970 116 p refs

(Grant NSF G-17993)

(AD-717498; NHRL-71-08) Avail: NTIS CSCL 4/2

Project STORMFURY is a joint ESSA-Navy program of scientific experiments designed to explore the structure and dynamics of tropical storms and hurricanes and their potential for modification. It was established in 1962 with the principal objective of testing a physical model of the hurricanes energy exchange by strategic seeding with silver iodide crystals. These crystals have been dispensed by Navy aircraft using Navy-developed special pyrotechnic devices. The hypothesis calls for reducing the maximum intensity of a storm or hurricane by a measurable amount. Navy and ESSA scientists and aircraft, supplemented by those of the U.S. Air Force, have cooperated in STORMFURY experimental operations since 1962 when the Project began. Until 1969, one mature hurricane (Beulah, 1963) and two series of tropical cumulus clouds (August 1963 and July-August 1965) had been experimentally seeded in the western Atlantic and Caribbean Sea. Author (GRA)

N71-22363# Air Force Global Weather Central, Offutt AFB, Nebraska.

THREE DIMENSIONAL NEPHANALYSIS

Allen R. Coburn 15 Mar. 1970 55 p refs

(AD-717653; AFGWC-TM-70-9) Avail: NTIS CSCL 4/2

The AFGWC objective three-dimensional nephanalysis program (3DNEPH) produces high resolution, three-dimensional analyses of clouds in the atmosphere. A horizontal grid spacing of approximately 25 nautical miles is used. Analyses are made for 15 layers from the earths surface to 40,000 feet MSL, with higher vertical resolution near the surface (150 feet depth for layer 1) and lower vertical resolution at the top of the model (5000 feet depth for layer 15). The program is a stream of individual processors. The active processors are: surface data processor, radiosonde data processor, aircraft data processor, satellite video data processor, decision tree processor, final processor and the special display processor. A description of each processor is given, along with some of the major decisions made within each processor. Author (GRA)

N71-22403+ Danish Meteorological Inst., Charlottenlund.

MONTHLY SURFACE TEMPERATURES ON THE NORTHERN ATLANTIC, 50 DEG-80 DEG N, 0 DEG-60 DEG W, 1968 [MANEDLIGE OVERFLADETEMPERATURER I DET NORDLIGE ATLANTERHAV, 50 DEG-80 DEG N, 0 DEG-60 DEG W, 1968]

1970 27 p In DANISH and ENGLISH

Avail: NTIS

The 1968 tables give for the area 50 to 80 deg N and 0 to 60 deg W for each 1 deg square (if observations are available) the average of the observed temperatures during the month in question, and the number of observations. The temperatures are given in tenths of degrees centigrade without decimal point; in order to facilitate the use of the tables the land areas are outlined in connection with the skeleton. Author

N71-22619*# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.

INVESTIGATION OF WARM FOG PROPERTIES AND FOG MODIFICATION CONCEPTS

Warren C. Kocmond, Ronald J. Pilie, William J. Eadie, Eugene J. Mack, and Richard P. Leonard Washington NASA Apr. 1971 113 p refs

(Contract NASw-1933)

(NASA-CR-1731; CAL-RM-2864-P-1) Avail: NTIS CSCL 04B

Warm fog seeding experiments were performed to determine the potential of various sized and unsized hygroscopic chemicals for fog dissipation. Urea, disodium phosphate and sodium chloride

were tested. Sized materials were most effective in causing fog dissipation but considerable leeway in sizing was tolerable. No firm conclusions were drawn with regard to the relative efficiencies of the three chemicals tested. The aerial seeding techniques employed were most effective during the latter stages of the life cycle of a fog. Wind measurements made at the field site established the presence of frequent and substantial turbulence in fog. This turbulence sometimes causes untreated fog to diffuse into cleared regions and degrades the effects of seeding. The computer model developed earlier to simulate the effects of seeding natural fog with hygroscopic materials was expanded to include vertical turbulent diffusion. Agreement of the model predictions with experimental results was demonstrated. Author

N71-22662# Lincoln Lab., Mass. Inst. of Tech., Lexington.
AIRBORNE SEVERE STORM SURVEILLANCE. VOLUME 1: SUMMARY AND RECOMMENDATIONS, 3–28 AUGUST 1970
James W. Meyer 17 Dec. 1970 63 p
(Contract F19628-70-C-0230; ARPA Order-512)
(AD-717719; TN-1970-43-Vol-1; ESD-TR-70-405) Avail: NTIS CSCL 4/2

The report of the Summer Study is presented in two volumes. Volume I, Summary and Recommendations, includes background material, the principal findings supported in most instances by brief discussion, and recommendations, in the form of brief statements, made as a result of the findings. Volume II, Reports of the Working Panels, contains material prepared by the Panels, which represents more detailed discussions in support of both the findings and recommendations. Airborne reconnaissance required to improve the forecasting and warning of severe tropical storms (hurricanes and typhoons), and to support efforts to achieve effective storm modification, is emphasized. Other methods of getting the necessary information and data are considered, and where appropriate, are recommended as part of the total system. Also discussed is the application of advanced groundbased and aerospace techniques to other kinds of violent weather, e.g., East Coast winter storms and violent thunderstorms producing tornadoes. While it is recognized that a degree of specialization is required for the most effective application of technology to problems, the severe storm surveillance system as a whole is viewed as an important national resource that can be used effectively in our defense against a variety of environmental hazards. Author (GRA)

N71-22684# Joint Publications Research Service, Washington, D.C.
METEOROLOGY
In its Soviet Bloc Res. in Geophys., Astronomy, and Space No. 248 16 Mar. 1971 p 4–10 (See N71-22682 11-30)
Avail: NTIS

Atmospheric and meteorological studies and instrumentation are briefly reported. Fluctuations of the refractive index in the surface layer of the atmosphere, distortions of aerosol size distribution, zonal circulation, vertical structure of atmospheric transparency, infrared attenuation by haze, and thermal sounding of the atmosphere are described. An instrument for measuring natural radioactivity in the free atmosphere and the radiosonde Meteorit 2 are mentioned, and a teachers' manual on recent advances in studying the earth atmosphere is reviewed. N.E.N.

N71-22687# Joint Publications Research Service, Washington, D.C.
UPPER ATMOSPHERE AND SPACE RESEARCH
In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 248 16 Mar. 1971 p 26–57 refs (See N71-22682 11-30)
Avail: NTIS

Abstracted data and news articles are presented. Electromagnetic wave propagation in the upper atmosphere, solar protons, auroral emission, radiation belt electrons, solar flare effects, whistler spectra, geomagnetic activity, and wind vector measurements are described. Cosmos launchings, Lunokhod 1 activities, and lunar geological observations are reported. N.E.N.

N71-22845# Israel Program for Scientific Translations, Ltd., Jerusalem.
CUMULI AND SHOWERS AT WARM FRONTS IN THE ARCTIC
L. A. Gevrilova *In its* Probl. of the Arctic and the Antarctic 1970 p 351–354 (See N71-22801 11-13)
Copyright. Avail: NTIS HC$6.00/MF$0.95

Analysis of the results of cumulus observations in flights over arctic areas led to the differentiation of two layers: (1) The first cumulus layer lies at altitudes of 200 - 600 m and has a small vertical thickness. These clouds reach 2,000 m only in isolated cases and produce squally shower-type precipitation in the form of sleet, rain, or hail showers. (2) The second cumulus layer lies above 1.5 –2.0 km and is of considerable vertical extent. The cumuli apexes may reach 5 km. Results of these examinations reveal that development of heavy cumulus formed by forced convection is possible at warm fronts in high latitudes, and as a rule this cloudiness is concealed from an observer below. A.L.

N71-22888# Israel Program for Scientific Translations, Ltd., Jerusalem.
SITUATIONS CHARACTERIZING VARIOUS STATES OF THE SIBERIAN ANTICYCLONE AND ITS NORTHEASTERN EXTENSION IN THE COLD PERIOD OF THE YEAR
A. A. Dmitriev *In its* Probl. of the Arctic and the Antarctic 1970 p 448–455 refs (See N71-22801 11-13)
Copyright. Avail: NTIS HC$6.00/MF$0.95

Some statistical data on various states and development stages of the northeastern extension of the Siberian anticyclone, in particular as related to atmospheric circulation forms in the first and second sectors of the hemisphere, are described. The states considered characterize to a certain extent the evolution of the Siberian anticyclone and associated pressure formations in adjacent regions in the course of two successive elementary synoptical processes or more. Both the states, and the statistical data presented, can be useful when preparing 3 to 10 day circulation and weather forecasts for the Arctic. A.L.

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N71-21916# Tennessee Univ., Knoxville.
SIMPLIFIED GUIDANCE AND CONTROL
J. M. Bailey 1 Apr. 1970 73 p refs
(Contract DAAH01-69-C-1264)
(AD-717567) Avail: NTIS CSCL 17/7

While formulating the optimum trajectory one must at the same time synthesize some form of corrective control action along the way. Economic considerations also dictate that this control scheme be as simple as possible commensurate with the desired system accuracy. One approach to such a requirement is to design a linear controller that attempts to keep deviations of some or all the state variables from a standard trajectory small. Directional Control which acts to keep the steady state normal velocity due to cross winds essentially zero is such a scheme. This report summarizes the status of investigations into such simplified schemes at the University of Tennessee under the contract. GRA

N71-21967# Lockheed-California Co., Burbank.
IMPROVED SONOBUOY COMPASS Final Report
Frank J. Fuller 30 Nov. 1970 58 p refs
(Contract N00014-69-C-0146)
(AD-717406; LR-23860; LAC/017992) Avail: NTIS CSCL 17/7

This report covers Phase II work on the compass research program. The Phase II work represents a change from the Phase I approach which used high power and typical flux gate data processing whereas Phase II used low power with Lockheed proprietary data processing methods. Application of this low power data processing approach reduced or eliminated previous Phase I problems with data pumping, harmonic distortion, and compass return to zero. In addition to investigation of sensor and data processing techniques, this report describes methods of meeting compass operational requirements at high latitudes and several approaches for stabilization of compass data against environmental forcing functions. Author (GRA)

N71-22338# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RADIO CONTROL OF MISSILES AND SPACE VEHICLES. PART 4: FEATURES OF THE RADIO CONTROL OF BALLISTIC MISSILES AND SPACE VEHICLES [RADIOUPRAVLENIE REAKTIVNYMI SNARYADAMI I KOSMICHESKIMI APPARATAMI. CHAST 4: OBOBENNOSTI RADIOUPRAVLENIYA BALLISTICHESKIMI RAKETAMI I KOSMICHESKIMI APPARATAMI]
L. S. Gutkin et al 11 Dec. 1970 192 p refs Transl. into ENGLISH from the Russian
(AD-717833; FTD-HT-23-699-70) Avail: NTIS CSCL 17/7

Radio-engineering systems for controlling the motion of space vehicles (SV) and intercontinental ballistic missiles (ICBM), based on general radio-control principles, have important features as compared with control systems of short-range rockets. The latter are continuously controlled for the entire duration or almost the entire duration of their flight from launching to target (although the control commands can also be generated discretely with a certain gap factor). Space vehicles are controlled for comparatively short time intervals which comprise a negligible portion of their total flight time. Therefore, such control may be called discrete, although commands can constantly be generated during these short intervals. This basic difference in control methods (continuous and discrete control) is stipulated by various control-system problems. The task of controlling short-range rockets is to destroy manuevering objects whose law of motion cannot be predicted. Hence, there also arises the problem of continuously controlling the rocket up to the time it encounters its target. A system for controlling a space vehicle or ICBM should make certain that the vehicle reaches a given point (area) of space at a given time with a given accuracy. Here, the vehicle should execute a motion along a precalculated fixed trajectory. Precisely this makes it possible to discretely control the vehicle, at least along certain segments of its trajectory. GRA

N71-22339*# TRW Systems Group, Redondo Beach, Calif.
THE APPLICATIONS OF SATELLITES TO COMMUNICATIONS, NAVIGATION AND SURVEILLANCE FOR AIRCRAFT OPERATING OVER THE CONTIGUOUS UNITED STATES. VOLUME 1: Technical Report
J. H. Craigie, A. Garabedian, D. D. Morrison, I. Zipper et al Dec. 1970 314 p refs
(Contract NAS5-21535)
(NASA-CR-117760; TRW-14671-6007-R0-00-Vol-1) Avail: NTIS HC $6.00/MF $0.95 CSCL 17G

Satellite applications to communications, navigation, and surveillance requirements are discussed for aircraft operating beyond 1975 over the contiguous United States and adjacent oceanic transition regions. The highest priority satellite applications are surveillance and rapid collision warning communications and it is concluded that the necessary technology is available. A system concept based on the technology was synthesized. A satellite-based air traffic control concept is described which consists of satellites, ground stations, and electronic hardware, and provides support for a wide range of aircraft. All users have a Location/Identification Transmitter (LIT) and antenna for surveillance which permits identification and three-dimensional location of all airborne aircraft approximately every second; and most of these aircraft are also equipped with LIT backlink receivers providing short access time mid-air collision warning. In addition, higher cost aircraft can have an option of satellite navigation equipment which can provide highly accurate three-dimensional position and velocity information. The use of satellites for rapid and reliable data communication from any place in the country to an aircraft anywhere over the country also is discussed. Author

N71-22340*# TRW Systems Group, Redondo Beach, Calif.
THE APPLICATIONS OF SATELLITES TO COMMUNICATIONS, NAVIGATION AND SURVEILLANCE FOR AIRCRAFT OPERATING OVER THE CONTIGUOUS UNITED STATES. VOLUME 2: APPENDICES
A. J. Mallinckrodt, C. S. Miller, C. S. Easley, G. E. Clark, R. J. Harte et al Dec. 1970 180 p refs
(Contract NAS5-21535)
(NASA-CR-117759; TRW-14671-6008-R0-00-Vol-2-App) Avail: NTIS CSCL 17G

Appendices of supporting information for the application of satellites to aircraft communication, navigation, and surveillance over the contiguous United States are presented including future air traffic control loads and air traffic system organization and management. Specific equipment studies are summarized including location/identification transmitter (LIT) pricing quotations; pulse detection and false alarm rates due to thermal noise and crosstalk; biphase coding; ground multipath; satellite LIT antenna optimization; computation of satellite transmitter linear range requirements for LIT; alternate design approaches for the LIT; aircraft antenna pattern measurements; a multiple tap surface wave delay line; and a LIT surveillance computer program. J.M.

N71-22379# Polhemus Navigation Sciences, Inc., Burlington, Vt.
VERTICAL NAVIGATION STUDY FOR THE CONCORDE SST. VOLUME 1: SUMMARY, SIMULATION, ANALYSIS AND RECOMMENDATIONS Final Report
Mar. 1970 28 p
(Contract UKTSD-C-4539)
(PNSI-TR-70-0301-1-Vol-1) Avail: NTIS

An analysis of vertical navigation for the Concorde aircraft is presented. Subjects discussed are: (1) computer simulation of the Concorde and its interrelated guidance systems, (2) evaluation of several levels and combinations of guidance system, aircraft performance, and meteorological forecast errors on ability to predict and achieve planned profiles over a variety of airline routes, (3) evaluation of the effects of certain air traffic control initiated commands on crew workload, fuel, schedule reliability, and controlled time of arrival, and (4) synthesis of additional operational techniques and equipment requirements to assure that air traffic control and crew performance requirements can be met. Author

N71-22380# Polhemus Navigation Sciences, Inc., Burlington, Vt.
VERTICAL NAVIGATION STUDY FOR THE CONCORDE SST. VOLUME 2: TECHNICAL, SIMULATION, ANALYSIS AND RECOMMENDATIONS Final Report
Mar. 1970 217 p
(Contract UKTSD-C-4539)
(PNSI-TR-70-0301-2-Vol-2) Avail: NTIS

For abstract see: N71-22379.

N71-22880* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ATTITUDE SENSOR FOR SPACE VEHICLES Patent
Norman M. Hatcher, inventor (to NASA) Issued 7 May 1968 (Filed 21 May 1964) 7 p Cl. 88-1
(NASA-Case-XLA-00793; US-Patent-3,381,569; US-Patent-Appl-SN-369334) Avail: US Patent Office CSLC 17G

An attitude sensor is described with mirrors which rotate through a scanning angle of at least 30 degrees. The radiation from the object being scanned is focused onto detectors. When the radiation fields of view cross, discontinuity exists at the edge of the object resulting in a change in the output of the radiation detectors. The output is fed into circuitry providing a pulse that is representative of the angular deviation of the sensor axis from the center of the object. This pulse is suitable for torquing or other systems which realign the vehicle associated with the sensor.
Official Gazette of the U.S. Patent Office

N71-22902 Royal Aircraft Establishment, Farnborough (England).
VLF PHASE DELAY VARIABILITY AND THE DESIGN OF LONG RANGE NAVIGATION AIDS
B. Burgess *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 19–33 refs (See N71-22901 11-07)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

A review is given of the experimentally determined characteristics of the propagation of VLF radio waves to great distances in the earth ionosphere waveguide, and these characteristics are examined in the light of waveguide mode theory. In particular the phase delay variations as a function of frequency, distance from transmitter, time of day, year, solar activity are discussed. Most of this experimental data refers to frequencies of 16 kHz and above. Included in this review are experimental data gathered during the past 12 months on OMEGA transmissions, and the role that the propagation data play in the design of a navigation system such as OMEGA is brought out. Author

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N71-21918# Naval Research Lab., Washington, D.C.
SM-1A REACTOR PRESSURE VESSEL SURVEILLANCE: IRRADIATION OF FOLLOW-ON CAPSULES IN THE SM-1 REACTOR
Charles Z. Serpan, Jr. 14 Dec. 1970 15 p refs
(Contract AT(49-5)-2110)
(AD-717618; NRL-7211) Avail: NTIS CSCL 18/9

Three capsules containing Charpy V-notch specimens of a duplicate ring-forging of SM-1A reactor pressure-vessel steel were prepared for placement into the SM-1A reactor as part of the continuing vessel surveillance program of that reactor. These capsules plus two more control capsules were irradiated in the SM-1 reactor at 440 degrees F (227 degrees C) to match the SM-1A reactor pressure-vessel transition temperature and fluence conditions prior to the SM-1A annealing. The capsules were then furnace annealed under the SM-1A reactor annealing conditions and were reirradiated in the SM-1 to the fluence and transition-temperature conditions of the SM-1A at the end of Core 3. Control points were established after each step. Significant differences in flux levels at a point in the SM-1 reactor were noted between an earlier flux-monitor irradiation and the subsequent surveillance-capsule irradiations. These differences were found to be directly related to the two different fuel cores in place at those times. Higher fluxes were generated at the core edge during the flux monitor irradiation since the core was old and the center was considerably burned out. Lower fluxes were measured at the same core-edge location during the surveillance-capsule irradiations since a new, smaller diameter core peaked in flux toward the center. The information developed and documented herein will be required for evaluation of the surveillance capsules after they are removed from irradiation in the SM-1A reactor. Author (GRA)

N71-22228# Army Engineer Reactors Group, Fort Belvoir, Va. Engineering Div.
SM-1A CORE 4 DESIGN ANALYSIS Final Report
Shrinivas S. Iyer, J. Randolph Langley, R. Stuart Saunders, and Richard R. Neuman 1 Jun. 1970 163 p refs
(AD-717561; ED-7006) Avail: NTIS CSCL 18/9

The report presents a detailed discussion of the anlytical technique used for the SM-1A core 4 design studies. The report gives background information of core 4, followed by a summary of the results obtained. The nuclear analysis, steady-state thermal-hydraulic behavior and transients accompanying certain types of accident situations are presented in subsequent chapters.
Author (GRA)

N71-22272# Oak Ridge National Lab., Tenn.
ENGINEERING PRACTICES FOR LARGE (4 INCHES AND OVER) GATE, GLOBE, AND CHECK VALVES IN WATER COOLED NUCLEAR REACTOR SYSTEMS
Jan. 1971 327 p refs Prepared in cooperation with NUS Corp., Rockville, Md.
(Contract W-7405-eng-26)
(ORNL-TM-3221) Avail: NTIS

Considerations relevant to the design, fabrication, and use of gate, globe, and check valves of 4-in. size and larger for water-cooled nuclear reactor systems are presented. Long-term reliability of these valves is a major design objective reflected in the discussions of their applications with respect to functional requirements, flow characteristics, design criteria and analyses, material requirements, fabrication, maintenance, and special design features. Techniques which can be used to determine how well these guidelines for achieving high reliability have been followed are also outlined. Author (NSA)

N71-22273# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.
REACTOR PRIMARY COOLANT SYSTEM RUPTURE STUDY Quarterly Report, Jul. – Sep. 1970
Oct. 1970 46 p refs
(Contract AT(04-3)-189)
(GEAP-10207-22; QR-22) Avail: NTIS

The research to improve the reliability of reactor piping was studied in failure mechanisms. The progress in the probability studies, low-cycle fatigue, and the effects of BWR environments is reported. F.O.S.

N71-22323# Argonne National Lab., Ill.
LIFE 1: A FORTRAN 4 COMPUTER CODE FOR THE PREDICTION OF FAST REACTOR FUEL ELEMENT BEHAVIOR
V. Z. Jankus and R. W. Weeks Nov. 1970 63 p refs
(Contract W-31-109-eng-38)
(ANL-7736) Avail: NTIS

The program LIFE 1 predicts the in-pile behavior of cylindrical fast reactor fuel elements. Assuming axial symmetry, the generalized plane-strain analysis combines models for fuel restructuring, migration of fuel constituents, fuel swelling due to the accumulation

of fission products, fission-gas release, hot pressing of the fuel, and cladding swelling due to void nucleation and growth. An iterative procedure allows the code to compute the detailed thermal and mechanical response of the fuel element during any specified history of normal reactor power cycling. Up to 10 axial sections are allowed to account for variations in power and coolant temperature, and an option is included for the treatment of encapsulated elements. Typical input for mixed-oxide stainless steel clad elements, some preliminary results, and a discussion of the input and output for LIFE 1 are included. Author (NSA)

N71-22327# Argonne National Lab., Ill.
INSTRUMENT PROBE FOR MEASURING TEMPERATURE AND PRESSURE IN THE UPPER PLENUM OF THE EBR-2 REACTOR. EBR-2 PROJECT
W. R. Wallin, R. O. Haroldsen, and K. J. Moriarty May 1970 30 p ref
(Contract W-31-109-eng-38)
(ANL/EBR-25) Avail: NTIS

Instrumentation has been installed to measure temperature and pressure of sodium in the upper plenum of the EBR-2 reactor vessel. The instrumentation includes eight thermocouples, positioned at eight different elevations, and two pressure detectors. These instruments are mounted in a thimble-like probe, which replaces a plug in an auxiliary hole designed for the fuel-handling gripper. The probe extends from the operating floor of the reactor building through the primary tank cover and the reactor vessel cover. Performance of the instrumentation is described. Author (NSA)

N71-22329# Battelle-Northwest, Richland, Washington. Pacific Northwest Lab.
FAST FLUX TEST FACILITY CONTAINMENT SYSTEM ALARM AND TRIP CRITERIA (ATMOSPHERIC RADIOACTIVITY MEASUREMENT STUDY)
M. Gustafson Hendrickson and V. W. Gilstafson Oct. 1970 31 p refs
(Contract AT(45-1)-2170)
(BNWL-1479) Avail: NTIS

Potential radioactive releases within the various cells and containment vessel of the fast flux test facility were reviewed and a basis was selected for identifying radioactivity release rates which require containment action. Noble gases were selected as the control isotopes and alarm and ventilation containment trip levels determined on the basis of calculated estimates of the airborne activity at a control point approximately 1/4 mile from the stack assuming all the activity has the characteristics of Ar-41. Alarm and containment trip levels are 0.0001 Ci/sec emission and 1.0 Ci/sec emission, respectively. An alarm level was chosen which would result in 1/10 the yearly average pevissible concentration at the control point, 1/4 mile from the stack. If activity levels greater than the alarm level, up to the trip level, persisted for the period of up to 8 hours, a manual ventilation containment trip would be recommended. Author (NSA)

N71-22351# Bettis Atomic Power Lab., Pittsburgh, Pa.
ANALYSIS OF THE TRANSIENT CAPABILITY OF ROD TYPE FUEL ELEMENTS (LWBR DEVELOPMENT PROGRAM)
W. R. Campbell and I. Goldberg Dec. 1970 11 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-979) Avail: NTIS

The capability of a bulk oxide, rod type fuel element to sustain a series of up-power transients that induces high strain rate in the cladding has been evaluated by comparing peak clad stresses and strains calculated by the CYGRO computer program with a set of stress-strain limits used for this evaluation. The generalized data of depletion capability developed herein are useful in determining fuel rod performance capability for a wide range of geometries and operating conditions, without having to run specific CYGRO calculations for each fuel element. Author (NSA)

N71-22377# General Electric Co., Pleasanton, Calif. Nucleonics Lab.
FISSION GAS RE-SOLUTION RATES Quarterly Report, 1 Jul.–30 Sep. 1970
M. O. Marlowe Sep. 1970 10 p refs
(Contract AT(04-3)-189)
(GEAP-12147; QR-1; Rept-3355-NL-17; Rept-130-DAC-12/70) Avail: NTIS

A description is given of the basis and experimental approach to the measurement of the re-solution rate of fission gases in oxide nuclear fuels. Twenty-eight UO2 disks were irradiated up to 3 × 10 to the 20th power fissions/cu cm. The specimens were characterized by optical, scanning electron, and transmission electron microscopy in the unirradiated condition. A technique for preparing specimens for transmission electron microscopy was proven out-of-cell, but some experimental difficulties were encountered in cell. A furnace for high-temperature anneals in-cell (1300 to 1600 C) was obtained, and suitable auxiliary equipment for atmosphere control is being fabricated. Work is in progress on the theoretical significance and temperature regime over which the re-solution process may be important in the interpretation of fuel behavior. Author (NSA)

N71-22378*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COHORT 2: A MONTE CARLO GENERAL PURPOSE SHIELDING COMPUTER CODE
Leonard Soffer and Lester Clemons, Jr. Washington Apr. 1971 79 p refs
(NASA-TN-D-6170; E-5783) Avail: NTIS CSCL 20H

COHORT-2 is a Monte Carlo general purpose shielding computer program written completely in FORTRAN-4 for the IBM-7094 computer. In its present form, it represents a major revision and modernization of the original COHORT code. It has been integrated into a single package with more flexible geometry and biasing. The code method employed is the conventional one where individual particles are generated, tracked, and analyzed. The shielding geometry allowed is flexible with space divided into homogeneous regions bounded by surfaces describable by a general quadratic equation. Spherical, cylindrical, and rectangular parallelepipeds are allowed for the source particles from preferred locations energies and directions. The exponential transform can also be used during particle tracking. Secondary gammas can be generated and placed on tape during a neutron problem to be tracked during a subsequent computer run. Output includes number fluxes in energy bins at arbitrarily located point detectors and averaged over regions. Energy integrated quantities such as dose rates are also obtainable. Author

N71-22419# Battelle Memorial Inst., Columbus, Ohio.
DEVELOPMENT OF FUELS AND TECHNOLOGY FOR ADVANCED REACTORS Progress Report, Jul.–Sep. 1970
Donald L. Keller Oct. 1970 112 p refs
(Contract W-7405-eng-92)
(BMI-1893) Avail: NTIS

Progress in three programs is reviewed: (1) uranium-plutonium nitride fuels for LMFBR applications, (2) nuclear fuels technology for advanced fast reactors, and (3) creep properties of reactor fuel materials. E.C.

N71-22424# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
EXPERIMENT DESCRIPTION AND HAZARDS EVALUATION FOR THE SERIES 1 ORNL OXIDE FUELS IRRADIATION IN EBR-2
A. R. Olsen and F. J. Homan Jun. 1970 16 p refs
(Contract W-7405-eng-26)
(ORNL-TM-2635-Suppl) Avail: NTIS

The operating conditions and safety of the Series I capsules were reevaluated to justify inclusion in a new subassembly to extend the target burnup level from 5% FIMA to an average of 10.5% FIMA. The analysis shows that such an extension is safe for these capsules in the peak flux position in an EBR-2IA-19 subassembly located in row 5, with the reactor operating at a power level of 62.5 MW. Author (NSA)

N71-22425# Babcock and Wilcox Co., Lynchburg, Va. Nuclear Power Generation Dept.

FAST BREEDER REACTOR STATIC PHYSICS METHODS DEVELOPMENT AND ANALYSIS PROJECT. VOLUME 1: FARED: ONE DIMENSIONAL FAST REACTOR PHYSICS DESIGN AND ANALYSIS CODE

D. H. Roy, J. M. Tilford, A. Z. Livolsi, P. N. Colpo, C. D. Carmichael et al Dec. 1970 197 p refs Revised

(Contract AT(30-1)-3867)

(BAW-3867-9-Vol-1-Rev-1) Avail: NTIS

The computer program FARED is described. The program is a one-dimensional static physics design code with an internal cross section collapse program; criticality, depletion, and search routines; fuel management capability; and a variety of edits including an extensive perturbation edit. Execution of the various routines in FARED is controlled by user directives, and all input is free format. Limitations and applications for the program are described. NSA

N71-22457# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

FAST REACTOR SAFETY TECHNOLOGY AND PRACTICES, LECTURE SERIES. VOLUME 1: SAFETY PRACTICES AND BACKGROUND INFORMATION

P. L. Hofmann, comp. Mar. 1970 245 p refs

(Contract AT(45-1)-1830)

(BNWL-SA-3093-Vol-1) Avail: NTIS

The question of reactor safety in relationship to the regulatory requirements and procedures of the AEC, is discussed. Plans and practices for safety assessment in order to meet these requirements and procedures are given. Author

N71-22458# Battelle-Northwest, Richland, Wash. Pacific Northwest Labs.

LECTURE SERIES: FAST REACTOR SAFETY TECHNOLOGY AND PRACTICES. VOLUME 2: ACCIDENT ANALYSES

P. L. Hofmann, comp. Mar. 1970 597 p refs

(Contract AT(45-1)-1830)

(BNWL-SA-3093-Vol-2) Avail: NTIS HC$6.00/MF$0.95

The aspects of fuel pin performance which relate to the safety characteristics of the fast test reactor are discussed. Postulated fuel failure mechanisms and thresholds for the principal classes of accidents in fast reactors are defined and then related to the design safety criteria for the fast test reactor. Author

N71-22511*# General Electric Co., Cincinnati, Ohio. Nuclear Systems Programs.

SNAP 8 REFRACTORY BOILER DEVELOPMENT PROGRAM: MERCURY THERMAL SHOCK TESTING OF 2 1/2-INCH-DIAMETER BIMETALLIC JOINTS FOR SNAP 8 APPLICATIONS Topical Report No. 4

S. R. Thompson [1970] 45 p refs

(Contract NAS3-10610)

(NASA-CR-72829; GESP-587) Avail: NTIS CSCL 18N

Coextruded and brazed tubular transition joints, between 2.5-inch-outside diameter tantalum and Type 316 stainless steel, were evaluated for usage in the SNAP-8 Mercury Power Conversion System. Representative joints were exposed to repeated thermal shocks by flowing 300 F mercury through the joints which were initially heated to 1300 F. Failure of the coextruded specimen occurred after 55 thermal shocks; no brazed joint failure was noted after testing to 100 and 155 cycles (two brazed samples). Posttest destructive and nondestructive examination of the sample assemblies indicated that the braze method produced assemblies which were essentially unaffected by the shock testing. The results of the above testing, and other severe thermal shock tests of this type of joint, show that the brazing method for effecting transitions between tantalum and stainless steel will produce a reliable joint for SNAP-8 applications. Author

N71-22512*# General Electric Co., Cincinnati, Ohio. Nuclear Systems Programs.

SNAP 8 REFRACTORY BOILER DEVELOPMENT PROGRAM: SHELL SIDE HYDRAULIC CHARACTERISTICS OF A FULL SCALE SNAP 8 MULTIPLE TUBE MODEL BOILER Topical Report No. 5

E. S. Hsia and R. A. Fuller [1970] 95 p refs

(Contract NAS3-10610)

(NASA-CR-72830; GESP-589) Avail: NTIS CSCL 18N

Shell side hydraulic characteristics of a full-scale SNAP-8 multiple-tube model boiler were thoroughly investigated over a turbulent Reynolds number range from 18,000 to 38,000. Friction factors for flow parallel to a tube bundle with or without turbulence promoters were determined experimentally. Loss coefficients for tube supporting spacers and exit or inlet manifolds were also measured experimentally. In addition, the effect of the incoming flow condition on these loss coefficients was investigated. With the aid of upstream dye injections, a visual study was made on the shell side flow distribution affected by turbulence promoters and the exit hole-slotted baffle. Results are presented in graphical forms. Author

N71-22591*# Humphreys Corp., Concord, N.H. TAFA Div.

INDUCTION PLASMA NOZZLE TESTS

John W. Poole and Charles E. Vogel Washington NASA Apr. 1971 48 p refs

(Contract NAS3-13227)

(NASA-CR-1765) Avail: NTIS CSCL 21F

An experimental program was conducted to establish induction coupled arc plasma systems with high exit gas enthalpies which could be used to study various nozzle designs. The objective of this work was closer simulation of the nozzle environment expected in the Gas Core Nuclear Rocket. Air plasmas with enthalpies up to 13,000 Btu/lb were developed and evaluation of transpiration cooled and seeded-transpiration cooled nozzles was conducted. It was shown that transpiration cooling reduces the thermal load to the nozzle and the seeded-transpiration cooling further reduces the thermal load. Author

N71-22618*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

MISSION PERFORMANCE POTENTIAL OF REGENERATIVELY COOLED GAS CORE NUCLEAR ROCKETS

Laurence H. Fishbach Washington Apr. 1971 19 p refs

(NASA-TM-X-2256; E-6092) Avail: NTIS CSCL 21F

The performance of regeneratively cooled gas-core nuclear rockets is compared to that of solid-core nuclear rockets for four missions: a reusable lunar ferry; a slingshot, in which an orbiting rocket boosts payloads to various hyperbolic excess velocities and then returns to orbit; and manned round trips to Mars and to Jupiter. The results indicate that gas-core nuclear rockets may offer a significant capability improvement for performing these missions, requiring only 50 to 75 percent of the initial mass in earth orbit needed by the solid-core rocket. In addition, high specific impulse, even with a corresponding increase in engine weight, seems desirable. Author

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N71-21870# Lehigh Univ., Bethelehem, Pa. Center for the Application of Mathematics.
PROPAGATION OF AN ELECTROMAGNETIC SHOCK DISCONTINUITY IN A NON-LINEAR ISOTROPIC MATERIAL
R. Venkataraman and R. S. Rivlin Nov. 1970 15 p ref
(Contract DAAD05-69-C-0053)
(AD-717305; CAM-110-12; BRL-CR-18) Avail: NTIS CSCL 20/6

The propagation of an electromagnetic shock discontinuity in a non-linear isotropic dielectric is studied. The velocity of propagation and the electromagnetic vectors behind the shock surface are determined in terms of the unit normal to the surface, the electric and magnetic induction fields ahead of the shock and their magnitudes behind the shock. Author (GRA)

N71-21882* North American Aviation, Inc., Downey, Calif.
OPTICAL PROJECTOR SYSTEM Patent
Robert A. Beam, inventor (to NASA) Issued 26 Dec. 1967 (Filed 9 Sep. 1966) 10 p Cl. 88-24 Sponsored by NASA
(NASA-Case-XNP-03853; US-Patent-3,359,855; US-Patent-Appl-SN-578931) Avail: US Patent Office CSCL 20F

The device comprises an optical projector system which projects an image for each eye, and which may take into consideration peripheral vision, as well as color, symbol and word recognition. The projector system also includes provisions to simulate vertical and horizontal eye movement, together with vertical, horizontal and angular head movement. The system does not require the cooperation of an actual observer. The image projector system includes the ability to provide for particular visual characteristics of individual observers. For instance, an instrument display may be arranged which provides for reductions and changes in normal visual limits from such factors as pressure unit visor restrictions, lack of sufficient oxygen, G forces, light versus dark adapted eyes, and moving the eyes farther away or near to the display panel.
Official Gazette of the U.S. Patent Office

N71-21883 Southern Illinois Univ., Carbondale.
ACOUSTICALLY INDUCED OPTICAL ANISOTROPY IN PURE LIQUIDS
Ward Arthur Riley, Jr. (Ph.D. Thesis) 1969 60 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 70-7311

The measuring technique is based upon a polarization analysis of the Frunhofer optical diffraction pattern which results from the spatially periodic photoelastic refractive index variation accompanying the acoustic pressure wave. For incident light traveling normal to and plane polarized at 45 deg with respect to the direction of propagation of the acoustic wave, the induced optical anisotropy will produce a change in the polarization of the light in the several diffraction orders. These changes may be directly related to the rotational diffusion time and optical anisotropy of the liquid molecules. The theory of ultrasonic light diffraction is employed together with existing theories for acoustically induced optical birefringence in pure liquids to relate the experimentally measurable quantities to the theoretical parameters of interest. In the far optical field, the isotropic photoelastic effect can be used as a phase reference with which the time dependent optical anisotropy can be compared, a comparison not possible in previous near field intensity measurements. Dissert. Abstr.

N71-21884 Minnesota Univ., Minneapolis.
DOMAINS OF ATTRACTION FOR MONOFREQUENT OSCILLATIONS IN WEAKLY NONLINEAR DYNAMICAL SYSTEMS
Douglas James Ness (Ph.D. Thesis) 1969 225 p
Avail: Univ. Microfilms: HC $10.15/Microfilm $3.00 Order No. 70-5592

A new approach to the determination of domains of attraction for monofrequent motions (i.e., motions occurring at essentially a single frequency) in finite neighborhoods of stable, static equilibrium configurations of n-degree-of-freedom, weakly-nonlinear dynamical systems is presented. Utilizing extensions of the asymptotic Method of Averaging, the approach is based on the construction and maximization of invariant sets in an appropriate three dimensional subspace of the space averaged system. Domains of attraction for certain constant solutions of this averaged system are obtained which extend as far as desired in one of the three spatial variables. These domains of attraction then are shown to yield estimates for the domains of attraction of the corresponding monofrequent motions of the original system. Dissert. Abstr.

N71-21885# Royal Aircraft Establishment, Farnborough (England).
ON THE MEASUREMENT OF THE NOISE IN THE NEIGHBOURHOOD OF BODIES IN SUBSONIC WIND TUNNELS, PART 2 [UEBER DIE GERAEUSCHMESSUNG AN UMSTROEMTEN OERPERN IN UNTERSCHALLWINDKANALEN TEIL 2]
G. Schulz Oct. 1970 37 p refs Transl. into ENGLISH of German report DLR-FB-69-86
(RAE-Lib-Trans-1465; DLR-FB-69-86) Avail: NTIS

The construction, effects, and evaluation of sound damping elements are discussed. Measurements were made on the spatial distribution of the sound in the measuring jet as well as its dependence on the speed of rotation of the fan and on the blowing speed. By a suitable theoretical procedure it is possible to separate the characteristic noise of the tunnel into its two parts, the fan noise and the free jet noise. Author

N71-21908# Harry Diamond Labs., Washington, D.C.
A CURRENT BEARING LOOP NEAR AN OBLATE SPHEROID
Orval R. Cruzan Jun. 1970 61 p refs
(AD-717306; HDL-TR-1512) Avail: NTIS CSCL 20/3

The general solution for the field due to a current-bearing circular loop near an oblate spheroid has been derived. The constitutive parameters, sigma sub 1, mu sub 1, epsilon sub 1, of the material composing the spheroid may have arbitrary values. However, since to evaluate this case numerically entails considerable difficulties, the quasi-stationary case involving a perfectly conducting spheroid was used. This case was further specialized by making the spheroid infinitely thin; that is a thin circular disk was obtained. For this special case, graphs were made of the magnetic lines of force, which illustrate their dependence on disk radius and separation of loop and disk. Also graphs are given for obtaining the flux for different circular cross-sections in the plane of the loop.
Author (GRA)

N71-21934# Denver Research Inst., Colo. Div. of Mathematical Sciences.
WAVE PROPAGATION PROBLEMS IN CLASSICAL PHYSICS Annual Summary Report, 1 Sep. 1969 - 31 Aug. 1970
Calvin H. Wilcox and John R. Schulenberger Nov. 1970 15 p refs
(Contract N00014-67-A-0394-0002)
(AD-717632; MS-R-7110; ASR-9) Avail: NTIS CSCL 12/1

The research reported here is concerned with a unified mathematical theory for a variety of wave propagation phenomena of classical physics. Examples of phenomena covered by the theory

include electromagnetic waves in free space and material media, acoustic waves in fluids, elastic waves in solids and electric waves on transmission lines, as well as many other less familiar phenomena such as Alfven waves (waves in an electrically conducting fluid which contains a magnetic field). The report describes progress made under the contract during the year, and contains a list of technical summary reports issued during the year. GRA

N71-21950# Fordham Univ., New York.
STUDY OF MAGNETIC ALLOYS: CRITICAL PHENOMENA Final Technical Report, 1 Jun. 1969 – 30 Nov. 1970
J. I. Bidnick, M. P. Kawatra, J. A. Mydosh, and S. F. Skalski Jan. 1971 6 p refs
(Contract N00014-69-A-0175-0001)
(AD-717389) Avail: NTIS CSCL 20/12

The report describes research carried out in the areas of transport properties (Electrical Resistivity, Thermoelectric Power) and magnetic susceptibility of magnetic alloy systems, both dilute and concentrated, of PdFe, PtFe, AuFe and some rare-earth Laves-phase compounds (GdNi2, GdPt2, GdRh2, GdAl2, GdCo2 and DyAl2). In these studies a special emphasis was placed on the behavior in the close vicinity of the ordering temperature. Author (GRA)

N71-21974# Institute for Defense Analyses, Arlington, Va. Science and Technology Div.
AN ANALYSIS OF ALIASING FOR SAMPLING ON COMPOSITE LATTICES
W. Duane Montgomery Nov. 1970 30 p refs
(Contract DAHC15-67-C-0011)
(AD-717819; P-677; IDA/HQ-70-1178) Avail: NTIS CSCL 20/6

In a previous paper, a quantitative analysis was given for the aliasing present in image transmission systems which sample the input with a two-dimensional periodic detector array. The present paper gives a quantitative analysis of the aliasing in similar systems, which produce a single picture by the superposition of several periodic samplings using a single detector array. The introduction of structure factor permits one to compute the precise reduction in amplitude of the aliased components that accompany the faithful image of each input spatial frequency. Author (GRA)

N71-22022 Ohio State Univ., Columbus.
DIFFRACTION BY A PLANE ANGULAR SECTOR
Ramon Stewart Satterwhite (Ph.D. Thesis) 1969 197 p
Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 70-8872

The exact solution for the electromagnetic field diffracted by a perfectly conducting plane angular sector is determined. The problem is a three dimensional vector problem and the solution is presented in the form of a dyadic Green's function, which is the most general form of solution possible. Thus the vector fields as well as the current on the sector are determined for any given source excitation. Dissert. Abstr.

N71-22113# Naval Research Lab., Orlando, Fla. Underwater Sound Reference Div.
UNDERWATER ELECTROACOUSTIC MEASUREMENTS
Robert J. Bobber Washington Jul. 1970 408 p refs
(AD-717318) Avail: NTIS HC $6.00/MF $0.95; SOD $3.00 CSCL 9/1

The electrical and acoustical measurements described in this book are those required to calibrate, test, or evaluate an underwater electroacoustic transducer and to enable one, indirectly, to produce or detect and measure an underwater acoustic signal, usually in terms of its acoustic pressure. These measurements will be referred to collectively as underwater electroacoustic measurements. Author (GRA)

N71-22143# Naval Underwater Systems Center, New London, Conn.
SOUND RADIATION FROM A GENERAL CLASS OF BODIES OF REVOLUTION
Hartley L. Pond 4 Nov. 1970 22 p refs
(AD-717594; NUSC/NL-3031) Avail: NTIS CSCL 20/1

A method for solving three-dimensional axially symmetric problems related to the diffraction and radiation from a general class of bodies of revolution is given. The method depends on the conformal transformation of the region outside the meridian profile of the body into the region outside a circle. The required boundary value problem is formulated in spherical coordinates in the transformed space. In this form, Galerkins method can be applied to obtain a functional approximation for the solution of the boundary value problem. Author (GRA)

N71-22220# Joint Publications Research Service, Washington, D.C.
NUMERICAL CALCULATION OF CONDUCTING FLUID FLOW IN A TRAVELING MAGNETIC FIELD
V. I. Panchuk et al *In its* Hydrodyn. Probl. of Bionics 12 Mar. 1971 p 145–152 refs (See N71-22201 11-05)
Avail: NTIS

Two dimensional unsteady flow of a viscous incompressible conducting fluid in an infinite channel in a constant longitudinal magnetic field was examined. On one of the channel boundaries was defined a longitudinal field in the form of a traveling wave. Assuming triviality of Reynolds magnetic number a magnetic field equation solution was found analytically, after which a numerical computation was made of fluid flow determined by the stated boundary conditions and corresponding electromagnetic force. The magnetic hydrodynamic equations and solutions used to solve the problems are presented. A.L.

N71-22224# Naval Postgraduate School, Monterey, Calif.
FINITE ELEMENT STUDY OF ACOUSTIC WAVES
Dennis Vale Dean (M.S. Thesis) Dec. 1970 71 p refs
(AD-717585) Avail: NTIS CSCL 20/1

The generation and propegation of small amplitude acoustic waves in a homogeneous, loss-free, compressible fluid is studied by the finite element method. A diaphragm mounted in an infinite rigid baffle generates acoustic waves in a semi-infinite fluid region. Steady-state pressure distribution is found for a hemispherical region with boundary reflection suppressed through use of a radiation condition. The computer program developed for the purpose utilizes iso-parametric finite elements with curvilinear boundaries. Incorporated in the program is a versatile mesh generator which minimizes the quantity of input data. Acceptable agreement with analytic results is obtained when there are at least four elements per wave-length. Author (GRA)

N71-22227# Massachusetts Inst. of Tech., Cambridge.
SHAPE FROM SHADING: A METHOD FOR OBTAINING THE SHAPE OF A SMOOTH OPAQUE OBJECT FROM ONE VIEW
Berthold K. P. Horn (Ph.D. Thesis) Nov. 1970 199 p refs
(Contract Nonr-4102(02))
(AD-717336; MAC-TR-79) Avail: NTIS CSCL 9/2

A method is described for finding the shape of a smooth opaque object from a monocular image, given a knowledge of the surface photometry, the position of the light source and certain auxiliary information to resolve ambiguities. This method is complementary to the use of stereoscopy which relies on matching up sharp detail and will fail on smooth objects. Until now the image processing of single views has been restricted to objects which can meaningfully be considered two-dimensional or bounded by plane surfaces. ... A number of applications of this method will be discussed including one to lunar topography and one to the

scanning electron microscope. In both of these cases great simplifications occur in the equations. A note on polyhedra follows and a quantitative theory of facial make-up is touched upon. An implementation of some of these ideas on the PDP-6 computer with its attached image-dissector camera at the Artificial Intelligence Laboratory will be described, and also a nose-recognition program. Author (GRA)

N71-22260# Naval Ordnance Lab., White Oak, Md.
A SOLUTION OF THE SYSTEM OF PARTIAL DIFFERENTIAL EQUATIONS WHICH DESCRIBE THE PROPAGATION OF ACOUSTIC PULSES IN LAYERED FLUID MEDIA
James R. Britt 17 Nov. 1970 58 p refs
(AD-717345; NOLTR-70-234) Avail: NTIS CSCL 20/1

The paper presents an exact solution of the system of partial differential equations which describe the propagation of sound waves in ideal fluid media of three homogeneous layers separated by parallel plane boundaries. The problem is generalized to the case of N layers. The solution is derived using a Laplace transform method developed by L. Cagniard. The method of separation of variables is used to find an eigenfunction expansion for the transformed problem. Then using several changes of integration variables, the inverse transform is obtained by direct identification without recourse to the complex Laplace transform inversion integral. Author (GRA)

N71-22426# School of Aerospace Medicine, Brooks AFB, Tex.
COCKPIT NOISE WITHIN TRAINER AIRCRAFT Final Report, Feb. - Oct. 1970
Donald C. Gasaway Dec. 1970 23 p refs
(AD-717852; SAM-TR-70-95) Avail: NTIS CSCL 20/1

Routine unprotected exposure to acoustic noise within cockpits of many trainer aircraft represents potentially hazardous stress. The character of the acoustic noise found within the cockpits of fixed- and ROTARY-wing aircraft used primarily for flying training is described and illustrated. The effect of various maneuvers commonly encountered in training flights on cockpit noise is evaluated, and factors of aeromedical significance associated with noise in trainer aircraft are identified and described. Author (GRA)

N71-22427# Catholic Univ. of America, Washington, D.C. Inst. of Ocean Science and Engineering.
ACOUSTIC WAVES TRANSMITTED THROUGH SOLID ELASTIC CYLINDERS
D. Brill and H. Uberall Sep. 1970 75 p refs
(Contract N00014-69-A-0432)
(AD-717738; R-70-10) Avail: NTIS CSCL 20/1

The acoustic field of a plane wave incident on an elastic cylinder may be decomposed into two parts, one representing circumferential waves that propagate around the cylinder, the other part obeying in the high-frequency limit the laws of geometrical optics. The latter part is studied in this paper, and is decomposed into the specularly reflected wave and into a series of transmitted waves which traverse the cylinder either directly along a secant, or undergo additional internal reflections with and without mode conversion (compressional to shear type, or vice versa). Wave front loci and amplitudes of these waves are calculated using the saddle point method, and the corresponding reflection and transmission coefficients are shown to reduce, for the case of a large cylinder, to the known expressions for a flat elastic half-space in contact with a liquid. Author (GRA)

N71-22467 Cornell Univ., Ithaca, N.Y.
AERODYNAMIC SOUND PRODUCTION AND THE METHOD OF MATCHED ASYMPTOTIC EXPANSIONS
Roy Keith Amiet (Ph.D. Thesis) 1969 113 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 70-5974

The method of matched asymptotic expansions is first applied to problems of sound generation by a body in an infinite fluid. The method is then extended to include a free stream flowing over the sound source. If the Mach number is less than one but is not small, slender body theory is assumed and the equations are linearized. The resulting modified wave equation is transformed to the usual wave equation by using a Lorentz and a Galilean transform, and the flow in this transformed plane is divided into an inner incompressible and an outer acoustic region. The effect of the shed vortices (for airfoil problems) on the order of the error is considered. The sound produced by a pulsating airfoil in a stream and the perturbation of a one dimensional sound wave by a moving elliptical airfoil are calculated as examples. In conclusion, the method of matched asymptotic expansions, when applicable, provides a simple method of determining acoustic sound fields. Dissert. Abstr.

N71-22468 California Univ., Berkeley.
ACOUSTIC WAVE AMPLIFICATION IN CROSSED ELECTRIC AND MAGNETIC FIELDS IN HIGH MOBILITY SEMICONDUCTORS
Kenneth Perry Weller (Ph.D. Thesis) 1969 159 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 70-6257

The direct current flow in two simple device structures used for crossed-field acoustic amplification is analyzed, and some properties which can affect the rf performance are studied in detail. Approximate formulas are derived for estimating the important flow parameters. The effect of this nonuniform flow on an acoustic beam is estimated. The deflection and refraction of a shear wave acoustic beam in InSb at 77 K is found to be very small, but the gain is strongly affected for large Hall angles. The high frequency performance of the crossed-field acoustic amplifier in limited dc power dissipation operation is compared with that of the conventional acoustic amplifier in which only an electric field is applied. Computer calculations of the optimum performance of both types of amplifiers using the best available materials show the crossed-field amplifier to be highly competitive for application in a low-loss delay line operating continuously above 2 GHz. Dissert. Abstr.

N71-22469# National Aerospace Lab., Tokyo (Japan).
AERODYNAMIC NOISE OF A CIRCULAR DOUBLE JET
Nagamasa Kono Sep. 1970 18 p refs In JAPANESE; ENGLISH summary
(NAL-TR-212) Avail: NTIS

The noise characteristics of a jet issuing from a coaxial double nozzle, of diameters of 3 cm and 6 cm respectively, are compared with those of a single jet. The far field sound pressure levels and spectrum at the mesh points, 3 m from the nozzle exit and at 30, 45, 60 and 90 degrees from the jet axis, respectively, were measured under various conditions of by-pass ratio, jet pressure and Mach number. At subsonic speeds, the maximum noise reduction was 4 db, corresponding to a mass flow ratio of 1.2 at 75% thrust increase. The reduced sound levels are mainly due to high frequency compenents, while the Strouhal number remains 0.24. At sonic speeds, the maximum noise reduction was about 10 db which is due to delayed shock turbulence interaction. At the same flow conditions mean velocity profiles and velocity fluctuation in the axial direction are investigated to clarify the mutual relation between the reduced noise, mean shear rate, and the turbulence characteristics. The results were that the maximum velocity fluctuation in the double jet was reduced to 1/3 of the single jet, which causes considerable noise reduction with alleviation of mean shear. Author

N71-22470# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FIBER OPTICS IN ELECTRON-OPTICAL SYSTEMS

[VOLOKANNAYA OPTIKA]
M. P. Lisitsa et al 15 Dec. 1970 77 p ref Transl. into ENGLISH from the Russian
(AD-717838; FTD-HC-23-506-70) Avail: NTIS CSCL 20/6

Such electron-optical devices as the cathode-ray tube (CRT), the image convertor (IC), and the multistage image intensifier, all of which are widely used in inspection and control systems and in automation and remote control, have some defects, in addition to their positive qualities. Information fed into these devices is recorded as an optical image on a luminescent screen, which is characterized, as a rule, by a low resolving power and a low luminous efficiency. The development of automation and computer technology requires a considerable increase in the resolving power and an improvement in the quality of the image obtained by these systems. An increase in the resolution of the CRT is particularly important because of its wide possible applications. The amount of information recorded on a CRT screen is determined by the size of the luminous spot of the phosphor. The smaller is the spot, the greater is the resolution of the screen, and the greater is the information that can be transmitted. Author (GRA)

N71-22491# Electrotechnical Lab., Tokyo (Japan).
REFERENCE STANDARDS FOR THE SPECTRAL RADIANT POWER IN THE ULTRAVIOLET, VISIBLE AND NEAR INFRARED REGIONS
Mamoru Suzuki Jan. 1970 115 p refs In JAPANESE; ENGLISH summary *Its* Circulars of the Electrotech. Lab. No. 167
Avail: NTIS

Spectral radiant power was measured by comparing the power to be measured with that of a reference source already established. Another method was to measure the radiant power directly using a thermopile or bolometer detector, where the absolute spectral sensitivity is also known. Reference standards included such sources as blackbody radiators, tungsten lamps, UV-standard lamps, and carbon arcs. Reviews are given on the blackbody radiation laws, radiation characteristics of the reference standards, and the calibrating method employed. Author

N71-22536# Cornell Univ., Ithaca, N.Y. Materials Science Center.
DIRECT ELECTROMAGNETIC GENERATION OF ULTRASOUND IN CONDUCTING LIQUIDS
M. R. Gaerttner and B. W. Maxfield Nov. 1970 8 p refs
(Contract AT(30-1)-2150)
(NYO-2150-65; MSC-1482) Avail: NTIS

Observation of electromagnetic generation and detection of acoustic waves are reported for mercury and cesium near room temperature. Results show that mercury compares relatively unfavorably from a generation standpoint with cesium. A simple Lorentz force-eddy current model, applicable to longitudinal wave generation in liquids, yields the same results (in the local limit) as a more detailed approach. However, the boundary conditions have a striking difference on the efficiency of generation. It is concluded that enhancement of direct generation in conducting liquids is possible if material chosen for the containment vessel is one to which the liquid in question will stick. E.M.C.

N71-22704# Air Force Cambridge Research Labs., Bedford, Mass.
ON THE FOUNDATIONS OF CRYSTAL OPTICS. PART 1: DISPERSION THEORY. PART 2: THEORY OF REFLECTION AND REFRACTION
P. P. Ewald 26 Aug. 1970 114 p refs Transl. into ENGLISH from Ann. Physik (Leipzig), v. 49, no. 1, no. 2, 1916
(AD-717697; AFCRL-70-0580; AFCRL-Trans-84) Avail: NTIS CSCL 20/6

The reports investigates the propagation of light in the visible region through a crystalline medium. In Part I, the objective is to determine if the anisotropic arrangement of ordinary (isotropic) dipoles at the nodal points of an orthorhombic lattice would account for the existence of double refraction. Some features of the traditional theory of dispersion are disclosed and clarified. In part II, a crystalline medium is considered as filling a half-space and having a plane boundary at $z=0$. A plane optical wave is incident on this medium. Because of the linearity of the equations it has to be superimposed on the field originating in the crystal. It is shown that this incident optical wave is actually prevented from entering the crystal because of the modification produced in the field of the crystal by the introduction of a boundary. Material Added 1970. The conclusion that the incident optical field cannot penetrate the crystal boundary, together with a similar conclusion in a paper by Oseen, is the basis of the Ewald-Oseen Extinction Theorem. Author (GRA)

N71-22761 North Carolina State Univ., Raleigh.
CURRENT ENHANCEMENT BY JOULE HEATING IN CADMIUM SULFIDE THIN FILMS
James Albert Hutchby (Ph.D. Thesis) 1969 113 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 70-9189

Nonlinear current versus voltage, I-V, characteristics were observed in CdS thin films. Direct current I-V characteristics reveal that the conduction process is linear for voltages less than 120 volts and is superlinear for larger voltages. Pulsed voltage I-V characteristics show that the degree of nonlinearity is an increasing function of the pulse width for a fixed pulse repetition frequency. The pulse characteristics suggest, therefore, that current increases to a steady-state value with time after a step voltage larger than 120 volts is applied. Transient current versus time data obtained for step voltages verify this conclusion. The data also suggest that the nonlinearity results from an increase of film conductivity caused by a significant temperature rise within the film. A model is presented in which the input electrical energy is equated to the sum of thermal energy absorbed by the film and thermal energy ejected from the film. Dissert. Abstr.

N71-22881* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CRYOGENIC INSULATION SYSTEM Patent
Porter J. Perkins, Jr., inventor (to NASA) Issued 23 Apr. 1968 (Filed 8 Dec. 1965) 3 p Cl. 220-9
(NASA-Case - XLE-04222; US-Patent-3,379,330; US-Patent-Appl-SN-512559) Avail: US Patent Office CSCL 20L

Cryogenic insulation is described in the form of panels that are self-evacuated at the time of use to provide the required quality of insulation. Prefabricated insulation panels comprising multilayers of shields and separators enclosed in a vacuum-tight flexible casing that contains a gas having a low vapor pressure at cryogenic temperatures are secured to the outer surface of a tank containing a cryogen. Official Gazette of the U.S. Patent Office

N71-23012 Pennsylvania State Univ., University Park.
FOURIER EXPRESSIONS FOR THE SCATTERING FUNCTIONS IN MIE'S THEORY WITH APPLICATIONS TO LIGHT SCATTERING BY SPHERICAL VOIDS IN RUBY
Eugene Alexander Margerum (Ph.D. Thesis) 1969 135 p
Avail: Univ. Microfilms: $6.40/Microfilm $3.00 Order No. 70-7228

An outline of Mie's theory of light scattering in the form needed is presented and the recurrence formula necessary for Mie computations are developed. It is demonstrated that the series for the amplitude functions in Mie's theory in truncated form are equivalent to finite Fourier cosine series in the scattering angle. Equations and computational methods are developed for producing sets of coefficients which facilitate the transformation of the Mie series into the Fourier series. Brief tables of these coefficients are also presented. It is further demonstrated that the corresponding intensity functions may also be expressed in the form of finite Fourier cosine series, and the equations for determining the Fourier coefficients are presented. Well known approximation formula

which hold for the case of very small scatterers are also reviewed and the equations for the corresponding Fourier coefficients are derived from them. The significance of these methods in analyzing angular scattering information is presented. Copies of the computer programs used are given. Dissert. Abstr.

N71-23014 Iowa State Univ. of Science and Technology, Ames.
MAGNETIC COUPLING IN COMPOSITE FERROMAGNETIC FILM STRUCTURES
Jish-Min Wang (Ph.D. Thesis) 1969 58 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 70-7765

The composite ferromagnetic film structure consists of two permalloy (81.7% Ni and 18.3% Fe) films with a thin separation layer of chromium and/or gold. When the easy axes of the two permalloy films are magnetically arranged to be in parallel, the effective coercive force of the ordinary film has the highest value. However, as the angle between the easy axes increases, the effective coercive force decreases accordingly; and finally it reaches its lowest value, the intrinsic wall coercivity, when the easy axes are mutually perpendicular. Experimental evidences indicate that both the magnetic coupling between the magnetizations and the magnetostatic interaction between the normal wall and the surface charge distribution are responsible for the observation of the so-called magnetically alterable coercive force. Dissert. Abstr.

N71-23016 California Univ., Los Angeles.
PROPAGATION OF ELECTROMAGNETIC WAVES ALONG A GYROTROPIC CLYINDER IN A LONGITUDINAL MAGNETIC FIELD
Yiefong Wang Chiang (Ph.D. Thesis) 1969 145 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 70-8122

Microwave propagation along a ferrite (gyromagnetic) and a semiconductor (gyroelectric) cylinder in a longitudinal dc magnetic field is theoretically studied. The objective is to investigate how the anisotropy and the boundary of the finite medium should affect the propagation characteristic of the electromagnetic waves. Derivation of the permeability tensor for magnetized ferrites is based on a phenomenological model. The magneto-static and the exact theories of wave propagation on a ferrite cylinder using a parameter-space mapping technique are developed. Resonance and cutoff loci in the parameter space are determined by limiting process. The merit of this technique is that dispersion relations of distinct classes of waves for any applied field and rod radius of a given ferrite/YIG material can be predicted accordingly. Dissert. Abstr.

N71-23017 Pennsylvania State Univ., University Park.
STUDIES OF THE OPTICAL PROPERTIES OF SOLIDS BY ELLIPSOMETRY
Wulfhart Helge Knausenberger (Ph.D. Thesis) 1969 94 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 70-7216

An ellipsometric method for the determination of all the optical parameters of an absorbing substrate with a transparent surface film on it is presented in two variations. When applied to cleaved silicon surfaces both methods show that the real part of the refractive index of Si is about 2% higher than that previously reported for etched Si. The results of similar work on Ge reveal that the refractive index of the oxide film which forms on Ge during thermal oxidation in the temperature range 560-620 C is much lower than the usually assumed value and corresponds closely to that of bulk glassy GeO2. Finally a theoretical analysis is presented which shows how to optimize the sensitivity of the ellipsometric arrangement for the determination of changes in optical constants by modulation techniques. The conclusions are experimentally proven by electroreflectance measurements on germanium. Dissert. Abstr.

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N71-21865 Colorado Univ., Boulder.
ELECTRON SPIN RESONANCE DETECTION OF MICROWAVE SECOND HARMONIC GENERATION IN RUBY
Peter Maas (Ph.D. Thesis) 1969 124 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 70-5871

A set of resonance lines at high magnetic fields were found in the E.P.R. spectrum of ruby. It is shown that these correspond to the absorption of second harmonic photons by the chromium ion. The second harmonic photons are themselves generated in the ruby sample, by some non-resonant process. Several mechanisms are discussed and evaluated with respect to the experimental data. A possible mechanism is found to be the microwave analog of optical second harmonic generation using the electric quadrupolar or magnetic dipolar contribution to the nonlinear polarization of the medium. Dissert. Abstr.

N71-21872 Northwestern Univ., Evanston, Ill.
THRESHOLD AND PRODUCTION OF LENGTH CHANGE INTRODUCED INTO PURE AND DOPED MgO WITH ELECTRON IRRADIATION BELOW 90K
James Edward Sickles (Ph.D. Thesis) 1969 26 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 70-6532

An attempt to improve the understanding of the damage mechanism in MgO is made and sensitive length change production measurements after bombardment by 0.30 to 2.0 MeV electrons in the temperature range 15 to 90 K are used to verify that elastic collisions are the predominate damage mechanism in MgO. Thin pure MgO specimens, bombarded with low energy electrons, were observed to contract until a saturation contraction was reached at low dose. At incident electron energies greater than 0.375 MeV (transition energy) the specimens expanded. The expansion production rate was found to increase with incident electron energy. Dissert. Abstr.

N71-21873 California Univ., Riverside.
AZBEL'-KANER CYCLOTRON RESONANCE IN THALLIUM
Jerry Carleton Shaw (Ph.D. Thesis) 1969 176 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 70-6371

The angular dependence of Azbel'-Kaner cyclotron resonance in single crystals of high purity thallium has been investigated at 24 GHz, and 1.4 K for sample surfaces perpendicular to the three principal crystallographic directions. These investigations have revealed sections of a Fermi surface that have not previously been reported. Detailed comparisons are made with the Fermi surface as determined by the nearly free electron band structure and by Soven's relativistic orthogonalized plane wave calculations. Cyclotron resonance for magnetic field directions making oblique angles with a (1010) surface has also been investigated. Revealed were highly anisotropic, large-amplitude resonances for magnetic field directions making angles of up to 80 deg with the sample surface. These resonances are attributed to extended orbits that are possible because of magnetic breakdown effects. Dissert. Abstr.

N71-21878# Northeastern Univ., Boston, Mass. Dept. of Physics.
MULTIPLE DENSITY CORRELATIONS IN A MANY PARTICLE SYSTEM
F. Y. Wu Feb. 1971 23 p refs

(Grants NSF GP-9041; NSF GP-25306)
(NUB-2053) Avail: Issuing Activity

A closed expression similar to the Ursell-Mayer expansion is obtained for the static multiple density correlation function I sub n = (rho sub k sub 1...rho sub k sub n) of a many particle system. It is shown that I sub n breaks into products of lower ones, if there exist partial momentum conservations among the k's. Using the convolution approximation for the n-particle correlation function, I sub n is evaluated in a closed form. The result is shown to be accurate in the small k region. Author

N71-21879 Arizona Univ., Tuscon.
KAON (+ OR −) PROTON ELASTIC SCATTERING AT 180 DEGREES FROM 0.40 TO 0.73 GeV/c
Paul Kendall Caldwell (Ph.D. Thesis) 1969 51 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 70-6664

The experiment detected the forward-scattered protons with scintillation counters. The K(+) p data are used to compute the p wave contributions to the scattering assuming S wave dominance. The P wave phase shift is found to be negative in the region 0.40 to 0.55 Gev/c. The K(−) p elastic differential cross-section is found to dip smoothly to a minimum (0 + or − 0.2 mb/steradian) at 0.66 Gev/c. Dissert. Abstr.

N71-21880 Virginia Polytechnic Inst., Blacksburg.
SIX PRONG EVENTS IN PION(−) PROTON INTERACTIONS AT 7.0 GeV/c
James Edward Campbell (Ph.D. Thesis) 1969 77 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 70-5350

Studies of 2250 events with 6 charged tracks in the final state from 7.0 GeV/c pion(−) proton film are reported. The events were fitted to the final states: (1) pion(−) proton yields 3 pion(−)2 pion(+)one proton (211 events), (2) pion(−) proton yields 3pion(−)2 pion(+) proton pion (zero), (535 events), and (3) pion(−) proton yields 3 pion(−) 3 pion(+) neutron (230 events). The total six-prong cross section is 2.40 + or − 0.27 mb. The partial cross section are: 0.22 + or − 0.04 mb for reaction (1), 0.58 + or − 0.09 mb for reaction (2), and 0.24 + or − 0.05 mb for reaction (3). Dissert. Abstr.

N71-21886 Colorado Univ., Boulder.
TIME-DEPENDENT PERTURBATION THEORY STUDIES OF A GROUND-STATE, MANY-FERMION SYSTEM
Robert William Jones (Ph.D. Thesis) 1969 214 p
Avail: Univ. Microfilms: HC $9.70/Microfilm $3.00 Order No. 70-5863

The diagrammatic, time dependent perturbation series is rearranged so that all the self energy structures are contained in a single function which has the role of a line weighting factor. These line weighting factors are related to the single particle occupation probabilities and are determined by the choice of the model single particle potential. A systematic procedure is developed for choosing a model single particle potential which satisfies the criterion of maximum effective inclusion of particle interactions. The model single particle energies resulting from this choice of the model single particle potential are shown to satisfy Landau's theory of a normal fermi liquid. This choice is compared with the existing choice based on the generalized time ordering procedure in the time independent Brueckner-Goldstone theory. Diagrammatic rules for writing out a general reaction matrix expansion are developed in time dependent perturbation theory. Dissert. Abstr.

N71-21949 Columbia Univ., New York.
STUDIES OF MOLECULAR MAGNETIC SUSCEPTIBILITIES BY HIGH RESOLUTION MICROWAVE SPECTROSCOPY
Harrison Saul Taft (Ph.D. Thesis) 1969 96 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 70-7082

Spectroscopy is used in conjunction with the Zeeman effect to measure magnetic susceptibility anisotropies in OCS and H2O. By combining this data with molecular bulk susceptibilities, the individual diagonal elements of the molecular magnetic susceptibility tensor are obtained. These are used, in turn, to derive sums of squares of electronic coordinates along the molecular principal inertial axes, which, when taken together, give a picture of the molecular electronic distribution. The sums of squares of electronic coordinates are also used in conjunction with the nuclear framework parameters to derive diagonal elements of the molecular quadrupole moment tensor. Alternatively, the diagonal elements of the rotational magnetic moment g-tensor to again yield the diagonal elements of the molecular quadrupole moment tensor. The theory of magnetic interaction of a freely rotating molecule is developed and the Zeeman patterns are predicted. Dissert. Abstr.

N71-21958# Gulf General Atomic, San Diego, Calif. Energy and Environmental Systems.
LINE AND CONTINUUM GAMMA-RAY YIELDS FROM THERMAL-NEUTRON CAPTURE IN 75 ELEMENTS Final Report
V. J. Orphan, N. C. Rasmussen, and T. L. Harper 31 Jul. 1970 687 p refs
(Contract DASA01-69-C-0151)
(AD-717639; GA-1024815; DASA-2570) Avail: NTIS HC $9.00/MF $0.95 CSCL 20/8

The document presents the results of an analysis of thermal capture gamma-ray spectral data obtained at the MIT Thermal Capture Gamma-Ray Facility using a Ge(Li)-NaI spectrometer. This data has been previously analyzed to obtain the energies and intensities of the resolved lines from radiative neutron capture in 75 natural elements. In the present work, the spectral data was unfolded to remove the effect of the spectrometer response, and the total gamma-ray yield for both discrete lines and continuum, was determined. The method of analysis, described previously by Harper and Rasmussen, is briefly summarized. Also discussed are the binding energies producing a consistent set of values. A comparison of some of the present results with previous data is given. The capture gamma-ray energies and intensities are tabulated and the original gamma-ray spectra are shown for each element. The total gamma-ray yield data for each element has been written onto magnetic tape in the ENDF format to facilitate the use of this data by radiation transport codes. A description of the tape preparation procedure and the data formats employed are given. Author (GRA)

N71-21959# Cornell Univ., Ithaca, N.Y. Lab. of Plasma Studies.
A LOW CURRENT LOW-ENERGY-SPREAD DUOPLASMATRON ION SOURCE
M. Steinberg, B. Yap, and H. H. Fleischmann Aug. 1970 12 p refs
(Contract N00014-67-A-0077-0002)
(AD-717398; LPS-57) Avail: NTIS CSCL 20/7

In the report the design and operation of a duoplasmatron ion source is described providing hydrogen ion currents of typically 0.1 mA having an energy spread of only about 5 eV. Author (GRA)

N71-21983*# National Aeronautics and Space Administration, Washington, D.C.
CLASSICAL PATH A AND B FUNCTIONS FOR LINE BROADENING OF POSITIVE IONS
J. Cooper, U. Palmer, and G. K. Oertel 25 Oct. 1970 48 p refs Sponsored in part by ARPA Prepared in cooperation with Joint Inst. for Lab. Astrophys.
(Contract DA-31-124-ARO(D)-139)
(NASA-TM-X-67048; AD-716435; JILA-105) Avail: NTIS CSCL 7/4

The A, a and B functions for electron broadening of positive ions, that is, with an attractive hyperbolic path, are considered in detail for the dipole interaction. Functions for a repulsive hyperbola and quadrupole interactions are also discussed. Author (GRA)

N71-22008# Pittsburgh Univ., Pa. Dept. of Physics.
RELATIVISTIC QUANTUM MECHANICS OF DYONS: EXACT SOLUTIONS
I. Bialynicki-Birula Nov. 1970 9 p refs
(Contract AT(30-1)-3829)
(NYO-3829-65) Avail: NTIS

Relativistic quantum mechanics of dyons (hypothetical particles endowed with both electric and magnetic charges is formulated. The hydrodynamical formulation of quantum mechanics is used to overcome all problems created by the simultaneous presence of both electric and magnetic charges. In the case of one dyon moving in the electromagnetic field of another dyon, the exact solutions are found and the energy levels are determined. Author (NSA)

N71-22009# Princeton Univ., N.J. Joseph Henry Labs.
EXISTENCE OF COMPLEX POLES AND OSCILLATORY AVERAGE MULTIPLICITY IN MULTIPERIPHERAL MODELS
Marvin L. Goldberger, Dennis Silverman (Calif. Univ.–La Jolla), and Chung-I Tan (Brown Univ.) 1970 11 p refs Sponsored in part by AEC
(Contract AF 49(648)-1545)
(NYO-2262-TA-228) Avail: NTIS

Using only the general factorization and nondegenerate thresholds properties of multiperipheral models, the existence of damped oscillatory components is demonstrated for both the total cross section and the rate of growth of average multiplicity, with identical frequencies and relative amplitudes. For weak oscillation, however, they are shown to be 180 deg out of phase. Relevant experimental information on these fine structures is also discussed. Author (NSA)

N71-22059# Joint Publications Research Service, Washington, D.C.
POSSIBILITIES OF LUMINESCENT ANALYSIS OF INDUSTRIAL AIR POLLUTION
E. T. Gaynullina et al *In its* Atmospheric Studies at Chem. Enterprises 9 Mar. 1971 p 53–67 refs (See N71-22055 11-13) Avail: NTIS

Theoretical bases for luminescent analysis are reviewed and light source devices used in the analysis are described. Topics discussed include the luminescence properties of organic compounds, the dependence of luminescence on molecular structure, analysis methods, and chemiluminescent gas analysis. Diagrams are given of an automatic fluorescent signal device for detecting toxic organophosphorous compounds and a fluorescent device for analyzing hydrogen sulfide. E.C.

N71-22088 Colorado Univ., Boulder.
A THEORETICAL AND EXPERIMENTAL STUDY OF CORONAL VISIBLE LINES FROM THE 3p5 3d CONFIGURATION OF THE ARGON 1 ISOELECTRONIC SEQUENCE
William John Wagner (Ph.D. Thesis) 1969 179 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 70-5901

The possibility that magnetic dipole transitions within the 3p5 3d configuration of Fe(IX) and Ni(XI) may contribute to the visible spectrum of the solar corona is reported. It was postulated that the lowest excited configuration 3p5 3d of Ar(I) sequence ions could produce coronal visible transitions. The energy levels of the 3p5 3d configuration were calculated from Ca(III) to Cu(XII) using a Hartree-Fock program. Magnetic dipole and electric quadrupole transition probabilities were computed for transitions between the levels. All predicted probabilities and wavelengths were transformed into intermediate coupling. Twenty-eight magnetic dipole transitions of appreciable strength in ions Cr(VII) to Cu(XII) were predicted to lie in the visible region. Dissert. Abstr.

N71-22089# Chicago Univ., Ill. Enrico Fermi Inst.
HYPERON BETA DECAY
Paul H. Frampton and Wu-ki Tung Nov. 1970 34 p refs
(Contract AT(11-1)-264)
(COO-264-563; EFI-70-65) Avail: NTIS

Polarized hyperon beta-decay is considered in the center of mass frame of the outgoing leptons. Simple and exact expressions are obtained for the differential intensity distribution function under the assumption of local current-current interaction and two component neutrinos. It is shown that by exploiting only the fully integrated data, it is possible to make a large number of tests on the structure of the Deltas = 1 current even with somewhat limited statistics. These include direct tests on the locality and V–A nature of the interaction without additional assumptions as well as detailed and rather stringent tests on the Cabbibo theory. Author (NSA)

N71-22090# Pennsylvania Univ., Philadelphia. Dept. of Physics.
PROGENITOR SUM RULES IN NUCLEAR PHYSICS
J. V. Noble [1970] 28 p refs Sponsored in part by AEC
(NYO-2171-328) Avail: NTIS

The classic method for generating relations like the Thomas–Reiche–Kuhn dipole sum rule or the f sum rule used in many-body theory is generalized. By considering the double commutators of various current-density operators with the nuclear Hamiltonian and concentrating on those which have simple forms, a more general class of sum rules than any previously applied to nuclear physics is established. These so-called progenitor sum rules acts as generating functions for all the previously known sum rules. With the hypothesis that certain giant states saturate the sum rules, approximate dynamical relations between various form factors are derived. Several examples are given by way of illustration, and some further applications are suggested. Author (NSA)

N71-22091# Argonne National Lab., Ill.
RABID: AN INTEGRAL TRANSPORT THEORY CODE FOR NEUTRON SLOWING DOWN IN SLAB CELLS
Arne P. Olson Apr. 1970 116 p refs
(Contract W-31-109-ENG-38)
(ANL-7645) Avail: NTIS

This report consists of the theory behind the methods used in the RABID code to solve the integral transport equation in slab geometry for cells with repeating boundary conditions, together with a user's guide, sample problems, and code listings. Space- and lethargy-dependent slowing down sources are used with cross sections obtained by the single level Breit-Wigner formalism for S- and P-wave resonances to calculate resonance absorption, broadgroup average fluxes and cross sections, and foil reaction rates. RABID is coded in FORTRAN-4 for the IBM/360-75. A core requirement of 420K bytes permits up to 300 resonances, 20 materials having resonances, 10 materials without resonances, 30 regions in the cell, and 25 broad groups. Author

N71-22092# Chicago Univ., Ill. Dept. of Physics.
HYPERON BETA-DECAY, ADDENDUM
Wu-ki Tung Dec. 1970 7 p
(Contract AT(11-1)-264)
(COO-264-563-Add) Avail: NTIS

To make a previous analysis of hyperon beta-decay complete, the sq q-spectrum of the decay rate and asymmetry functions are discussed. It is shown that these spectra provide a valuable source of information on the hard to measure form factors f sub 2 and g sub 2. Author (NSA)

N71-22111 California Univ., Berkeley.
VIBRATION TO VIBRATION ENERGY TRANSFER IN LASER EXCITED CARBON DIOXIDE
Robert Eriksen Wood (Ph.D. Thesis) 1969 102 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 70-6260

Measurements were made of the decay in fluorescence from the asymmetric stretching vibrational level of CO2 samples following their excitation by a Q switched CO2 laser operating on the 10.6 micron, (00 deg 1) to (10 deg 0), transition. Presented are vibration-to-vibration energy transfer rates from the (00 deg 1) level due to collisions with CO2; with C2D4, CD2CH2, Cd3I, CD3Cl and CD4 which have a C-D stretch nearly resonant to the (00deg 1) level of CO2; with CH4, H2, He, Ne, He4 and Xe; and with CO16O16. For the cases of CO2, H2, He, Ne and Xe the temperature dependence of these rates is presented for the range from 300 to 700 K; for the rare gases this dependence corresponds to the expectations of an intramolecular vibrational energy transfer theory based on a short-range repulsive exponential potential producing transitions between the vibrational levels of CO2. The effects of anharmonicities and Coriolis coupling are included in the calculations. The experimental methods used to produce and analyze the fluorescence signals are discussed in detail as in the use of a computer for on-line averaging of these signals. Dissert. Abstr.

N71-22112 Columbia Univ., New York.
DYNAMICS OF RELAXATION IN MANY BODY SYSTEMS
George Dewey Harp (Ph.D. Thesis) 1969 235 p
Avail: Univ. Microfilms: HC $10.60/Microfilm $3.05 Order No. 70-6990

Static and time dependent correlation functions for liquids of carbon monoxide and nitrogen were studied using computer simulated molecular dynamics. The structures of the linear and angular momentum autocorrelation functions from these studies appear to be determined by the corresponding autocorrelation functions of the direction of the linear and angular momentum. The structure of the angular momentum autocorrelation function is also shown to depend on the strength of the noncentral part of the pair potential used in the dynamics calculations. The assumptions that the linear and angular momenta are Gaussian random variables are examined and shown to be valid for the data presented. Dissert. Abstr.

N71-22118# Naval Post Graduate School, Monterey, Calif. Dept. of Physics.
FORMATION CROSS SECTION OF H2(+) IN THE REACTION OF FAST PROTONS AND METHANE
John Thomas Mitchell, Jr. (M.S. Thesis) Sep. 1970 64 p refs
(AD-717610) Avail: NTIS CSCL 7/4

The cross section for the formation of H2(+) in the reaction H(+) + CH4 yields H2(+) + CH3 was measured at scattering angles of 43 to 49.5 deg and incident proton energies of 70, 100 and 150 eV. For 150 eV the cross section showed no peak as a function of scattering angle. For 70 and 100 eV a pronounced peak was observed around a scattering angle of 46 deg. The angular position of the peak, the magnitude and the energy dependence of the cross section were in accordance with the classical theory of ion-molecule rearrangement collisions proposed by Bates, Cook and Smith. Author (GRA)

N71-22119# Arizona Univ., Tucson. Dept. of Physics.
OPERATION OF VAN de GRAAFF ACCELERATORS FOR BASIC EXPERIMENTS IN ATOMIC SPECTROSCOPY Final Report, 1 Apr. 1967 - 30 May 1970
Stanley Bashkin Jan. 1971 10 p refs
(Contract N00014-67-A-0209-0005)
(AD-717403) Avail: NTIS CSCL 7/4

A brief summary is given of studies in the field of beam-foil spectroscopy. The research related to the measurement of transition energies in atoms and ions, and the mean lives and quantum numbers associated with excited electronic levels. Much of the work was devoted to structure of multiply-ionized systems. The report includes a list of all published papers and the names of all people associated with work under the contract. Author (GRA)

N71-22234# Stanford Univ., Calif. High Energy Physics Lab.
ELECTRON SCATTERING FROM ALIGNED AND NON-ALIGNED Ho 165 NUCLEI
F. J. Uhrhane, J. S. McCarthy, and M. R. Yearian Dec. 1970 15 p refs Submitted for publication Sponsored in part by NSF (Contract Nonr-225(67))
(AD-717615; HEPL-644) Avail: NTIS CSCL 20/8

The differential scattering cross sections have been measured for electron scattering from randomly oriented and aligned Ho165 nuclei. The alignment axis was parallel to the direction of the momentum transferred to the nucleus. Incident electron energies from 160.6 MeV to 462.2 MeV were used at a fixed polar scattering angle of 36 degrees. Available theories are unable to explain the measured difference between the aligned and non-aligned cross sections. Author (GRA)

N71-22235# Stanford Univ., Calif. High Energy Physics Lab.
NUCLEAR FERMI MOMENTA FROM QUASI ELASTIC ELECTRON SCATTERING
E. J. Moniz, I. Sick, R. R. Whitney, J. R. Ficenec (Va. Polytech. Inst.), R. D. Helphart (Va Polytech Inst.) et al Jan. 1971 12 p refs Submitted for publication
(Contracts Nonr-225(67); F44620-68-C-0075)
(AD-717616; HEPL-646; ITP-377) Avail: NTIS CSCL 20/8

The cross sections for quasi-elastic electron scattering from nine target nuclei from lithium to lead have been measured for electron incident energy of 500 MeV and scattering angle of 60 degrees. The data are interpreted in terms of a Fermi gas model, yielding the nuclear Fermi momentum as a function of atomic number. The Fermi momentum increases from lithium to calcium and remains roughly constant at about 260 MeV/c from nickel to lead. Author (GRA)

N71-22248# Stanford Linear Accelerator Center, Calif.
RECENT DEVELOPMENTS IN INELASTIC ELECTRON-NUCLEON SCATTERING
Frederick J. Gilman Nov. 1970 30 p refs Presented at the Symp. on Hadron Spectry., Balatonfured, Hungary, 6 - 11 Sep. 1970 Sponsored by AEC
(SLAC-PUB-842; CONF-700937-1) Avail: NTIS

A review is given of the experimental and theoretical aspects of inelastic electron-nucleon scattering. In this discussion particular attention is devoted to some theoretical consequences of recent experimental data and to duality and resonance behavior. NSA

N71-22274# General Electric Co., Schenectady, N.Y. Knolls Atomic Power Lab.
NOTES ON THE CARBON TOTAL CROSS SECTION FROM 0-2 MeV
Norman C. Francis [1970] 17 p refs Presented at the FANDC Symp. on Neutron Standards and Flux Normalization
(Contract W-31-109-eng-52)
(KAPL-P-3901; CONF-701002-2) Avail: NTIS

Because of its smooth energy dependence, the total cross section of carbon is studied as a good candidate for a primary standard for the measurement of neutron cross sections from 0 to 2 MeV. The C-13 content of natural C can be ignored for errors greater than 1%. The results of several measurements of the thermal cross section are given, and polynomial fits are made to the data. The binding energy and n + C elastic scattering are also

considered. It is concluded that, if the energies of the C-13 resonances are avoided, the carbon total cross section is known to about 1%, and the angular distribution to about 10%. NSA

N71-22275# Maryland Univ., College Park. Dept. of Chemistry.
DIRECT INTERACTION EFFECTS IN THE FISSION OF U 238 WITH 63.5-MeV He 4 ions
V. E. Viola, Jr., M. M. Minor, A. E. Salwin, R. O. Bondelid (Naval Res. Lab., Wash., D. C.), and R. B. Theus (Naval Res. Lab., Wash., D. C.) Sep. 1970 29 p refs Sponsored in part by Naval Res. Lab.
(Contract AT(40-1)-3783)
(NNC-3783-7) Avail: NTIS

Position-sensitive semiconductor detectors were used to measure both in-plane and out-of-plane angular correlations for binary-fission events from 63.5-MeV He-4 induced fission of U-238. From these data a value of 7.5 + or − 1.0 percent is derived for the contribution of direct-interaction mechanisms to the total fission cross section at 63.5 MeV. When this result is included with recent theoretical expressions, the interpretation of fission-fragment angular-distribution data is found to be consistent with both theory and low-energy results up to this energy. The most probable total kinetic-energy release was found to be 173.3 + or − 5.4 MeV for the compound nucleus Pu-242. The measured variations in the average fission-fragment kinetic energies and the widths of the fragment spectra as a function of correlation angle are interpreted in terms of effects arising from direct interaction, neutron evaporation, and the reaction kinematics. Author (NSA)

N71-22280# Oxford Univ. (England). Engineering Lab.
MONTE CARLO CALCULATIONS OF SMALL ANGLE PLURAL SCATTERING
R. G. Lord and P. Rockett Jan. 1971 16 p refs
(Rept-1000/71) Avail: NTIS

The small angle plural scattering of a well collimated beam of monoenergetic particles by a collection of stationary scatterers has been investigated by means of Monte Carlo calculations. The theoretical and Monte Carlo results are compared with the predictions of a simple model of plural scattering based on observations of small angle scattering of medium energy electrons in gases. Author (ESRO)

N71-22284# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
NATURAL TRANSPORT EFFECTS ON FISSION PRODUCT BEHAVIOR IN THE CONTAINMENT SYSTEMS EXPERIMENT
R. K. Hilliard and L. F. Coleman Dec. 1970 184 p refs
(Contract AT(45-1)-1830)
(BNWL-1457) Avail: NTIS

The results of six experiments in the 26,500 cu ft containment systems experiment containment vessel are reported. In these tests, no active safety feature operated and all transport was by natural passive processes. The time dependence of iodine, methyl iodide, cesium, ruthenium, and uranium concentrations was measured at various locations in the vapor space and in the steam condensate. Parameters which were varied from test to test included the ratio of surface area to volume, temperature and pressure of the atmosphere, heat transfer rate to walls, paint age, and initial iodine concentration. The best estimates of the 2-hr dose reduction factor (DRF) due to fission product removal by natural processes for large PWR containment systems are about 2.6 for inorganic iodine, 1.15 for particulate matter, and 1.0 for methyl iodide. At longer times the estimates for DRF are considerably larger. Author (NSA)

N71-22285# Brown Univ., Providence, R.I. Dept. of Physics.
SINGULAR OFF-MASS-SHELL EQUATION WITH VECTOR MESON EXCHANGE
T. C. Chen and K. Raman (Wesleyan Univ., Middletown, Conn.) Oct. 1970 46 p refs Sponsored by AEC
(NYO-2262-TA-232) Avail: NTIS

A method is suggested for handling the singular Blankenbecler-Sugar-Logunov-Tavkhelidze equation for the scattering of two spin-zero particles through the exchange of a vector meson. First the Born term describing vector meson exchange is defined in such a way as to minimize the degree of singularity of the equation. A distorted-wave method is then used for the modified equation, which is still marginally singular. This reduces the problem to that of solving a Fredholm equation. Numerical solutions are obtained for the low energy S wave and P wave amplitudes and resonances. Author (NSA)

N71-22286# Brookhaven National Lab., Upton, N.Y.
PARTICLE SEPARATION IN A SYSTEM OF CONVENTIONAL IRIS-LOADED DEFLECTORS INTERSPERSED WITH ALTERNATE GRADIENT MAGNETS
D. Lazarus 12 Nov. 1970 26 p Sponsored by AEC
(BNL-15438) Avail: NTIS

A long-pulse, room-temperature rf separator based on a series of conventional S-band iris-loaded deflectors with magnets of a strong focusing channel between them is considered. A calculation of particle motion in such a system has been carried out which is exact except for aberrations whose effect on the results is shown to be negligible. Performance parameters and particle fluxes are given for separators designed for the 1 to 5 GeV/c and 5 to 15 GeV/c ranges. Implications for purified beams for counter and spark chamber experiments are discussed. Author (NSA)

N71-22352# Argonne National Lab., Ill.
SERVICE ROUTINES FOR THE MULTIGROUP CROSS-SECTION CODE MC SUP 2
E. M. Pennington, J. C. Gajniak, A. B. Cohen, and W. Bohl Apr. 1970 74 p refs
(Contract W-31-109-eng-38)
(ANL-7654) Avail: NTIS

The FORTRAN codes MERMC2 and MAGIC are service routines for binary cross-section library tapes used by the MC sup 2 multigroup cross-section code. MERMC2 requires as input two MC sup 2 library tapes and produces another library tape containing data from the input tapes with deletion of some materials if desired. Alternately, MERMC2 may be used to produce a library tape by deleting materials from a single input tape. The MAGIC code yields listings and Calcomp plots of selected data from an input MC sup 2 library tape. Author (NSA)

N71-22359# Maryland Univ., College Park. Dept. of Physics and Astronomy.
THEORETICAL STUDIES IN NUCLEAR REACTIONS AND STRUCTURE Progress Report
Sep. 1970 35 p refs
(Contract AT(40-1)-3765)
(ORO-3765-28) Avail: NTIS

Studies on the Bethe–Goldstone equation in finite nuclei, major shell mixing with a density dependent effective G-matrix, the generator coordinate method for light nuclei, relativistic formulation of the many-body problem using excitation as variational parameters, relativistic Green's function approach to nuclear matter, three-body forces in nuclear matter, spin-orbit splitting in nuclei, reactions involving elementary particles and nuclei, extraction of the two-nucleon T-matrix from reaction data, shell model reaction theory, three body effect, model three body problem with breakup, reactions induced by multi-nucleon projectiles, and nuclear fission and statistical nuclear reactions are briefly described. NSA

N71-22368# Aerospace Corp., El Segundo, Calif.
DOPPLER LINE SUPER RADIANT EMISSION FROM A SPHERE
George Emanuel 30 Dec. 1970 21 p refs
(Contract F04701-70-C-0059)
(AD-717724; TR-0059(6240-20)-4; SAMSO-TR-71-19) Avail: NTIS CSCL 7/4

A simple theory is given for the super-radiant emission from a uniform spherical gaseous medium. The emission stems from a Doppler broadened transition with positive gain. Application of the theory to a recent fluorescence experiment shows that super-radiant emission does not account for the decay of the population in the upper level. Author (GRA)

N71-22369# Purdue Univ., Lafayette, Ind. Dept. of Physics.
E2/M1 MULTIPOLE MIXING RATIOS IN THE SPHERICAL NUCLEI Te-124, Te-126, AND Xe-126
Z. W. Grabowski, K. S. Krane, and R. M. Steffen [1970] 25 p refs
(Contract AT(11-1)-1748)
(COO-1746-51) Avail: NTIS

E2/M1 mixing ratios of the 709-keV, 714-keV, and 723-keV transitions in Te-124, the 754-keV transition in Te-126, and the 491-keV transition in Xe-126 were measured using the gamma-gamma directional correlation technique. In addition, the measurements on the 646-keV–603-keV, 1691-keV–603-keV, and 2091-keV–603-keV gamma-gamma cascades in Te-124 are in agreement with pure E2 character of 646-keV transition and with pure E1 character of the 1691-keV and 2091-keV transitions in Te-124. Coaxial Ge(Li) and NaI(Tl) scintillation detectors were used in different combinations depending on the energy resolution required for a particular measurement. The results for the mixing ratios are given. There is an indication that the mixing ratios for the 2+' yields 2+ transitions in even–even tellerium isotopes are negative and the mixing ratios of similar transitions in even–even Xe isotopes have positive values. Author (NSA)

N71-22370 West Virginia Univ., Morgantown.
THE NUCLEAR SPIN LATTICE RELAXATION TIME OF LITHIUM-MAGNESIUM ALLOYS
William Edward Wallace, Jr. (Ph.D. Thesis) 1969 101 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 70-6333

The nuclear spin lattice relaxation time of lithium-magnesium alloys is determined for concentrations of magnesium up to 26 atomic percent. Measurements are made at 4.2 deg Kelvin by recording the growth of the resonance signal as the nuclear spin system recovers from saturation. A technique employing phase sensitive amplification is used to enhance the signal to noise ratio of the measurements. A second order polynomial fit to the data gives the functional relationship between T1 and atomic percent magnesium, for up to 18 atomic percent magnesium. The relationship between T1A, the component of T1 representing the effect of alloying, and atomic percent magnesium is found. The results qualitatively substantiate theories which propose the Fermi surface of pure lithium is not in contact with the Brillouin zone boundary. Dissert. Abstr.

N71-22402 Missouri Univ., Columbia.
EPR STUDIES OF IMPURITY IONS AND F(+)-CENTERS IN SINGLE CRYSTALS OF BARIUM OXIDE
Kenneth Earl Mann (Ph.D. Thesis) 1969 139 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 70-6609

Using electron spin resonance the isotropic and anisotropic and hyperfine constant and the quadrupole interaction were determined for the nuclei (Ba-137 and Ba-135) in the vicinity of a F(+)-center in BaO. The paramagnetic resonance spectrum of Gd(3+) in BaO was analyzed at 3 cm wave length at liquid nitrogen temperatures. The fine structure constants and the isotropic hyperfine constants for Gd-157 and Gd-155 were evaluated for the spin Hamiltonian. Dissert. Abstr.

N71-22432# Wisconsin Univ., Madison.
MAGNETIC MOMENTS OF THE 7/2(MINUS) MIRROR STATES IN Ar 37 AND K 37
W. L. Randolph, Jr. and R. R. Borchers [1970] 7 p refs Presented at the Conf. on Hyperfine Interactions Detected by Nucl. Radiation, Jerusalem Sponsored by AEC
(COO-7-565; CONF-700933-2) Avail: NTIS

The magnetic moments of the 7/2(−) states in K-37 and Ar-37 are reported. The latter was determined to be −1.35 + or − 0.06 nm from the reaction Cl-37(p,n)Ar-37 at E sub p of 4.850 MeV; the lifetime of Ar-37 was measured as 4.66 + or − 0.16 ns. The magnetic moment of K-37, from the Ca-40(p,alpha)K-37 reaction at 13.0 MeV, was found to be 5.29 + or − 0.26 nm. The lifetime determined for the 1.380-MeV state in K-37 was 10.82 + or − 0.43 ns. NSA

N71-22434# Syracuse Univ., N.Y. Dept. of Physics.
INEQUALITIES FOR THE s AND p WAVE pion pion PARTIAL WAVE AMPLITUDES
A. P. Balachandran (Tata Inst. of Fundamental Research) and Maurice L. Blackmon Aug. 1970 25 p refs Supported in part by AEC
(SU-1206-234; NYO-3399-234) Avail: NTIS

An infinite number of inequalities for integrals over the s and p wave pion pion amplitudes in the interval 0 < or = to s < or = to 4m(pion)sq in terms of the pion pion total cross sections and other experimentally accessible data are derived. The main ingredients in the derivations are crossing symmetry, the positivity of the even 1 > or = to 2 partial waves of the reactions pion(0)pion(0) yields pion(0)pion(0) and pion(0)pion(0) yields pion(+)pion(−) in the interval 0 < or = to s < or = to 4m(pion)sq and some known bounds on the crossed channel absorptive parts of these reactions. It is shown that if the partial-wave sum over any subset of pion(0)pion(0) yields pion(0)pion(0) partial waves is itself invariant under permutations of s, t, and u and this subset contains the s wave, then the entire pion(0)pion(0) yields pion(0)pion(0) amplitude has to vanish identically. (Actually, a somewhat stronger result is proved for the amplitudes of both the processes pion(0)pion(0) yields pion(0)pion(0) and pion(0)pion(0) yields pion(+)pion(−) or for any linear combination of these amplitudes with positive coefficients.) Author (NSA)

N71-22435# Washington Univ., Seattle. Nuclear Physics Lab.
SPIN ISOMERS OF THE SHAPE ISOMER Pu 237m
P. A. Russo, R. Vandenbosch, M. Mehta, J. R. Tesmer, and K. L. Wolf [1970] 28 p refs Sponsored by AEC
(RLO-1388-130) Avail: NTIS

Two components in the spontaneous fission decay of Pu-237m are investigated. The half-lives of the two isomers are 82 + or − 8 nsec and 1120 + or − 80 nsec. The production ratio of the two components was determined for three different bombarding conditions: U-235 + 24 MeV alpha U-235 + 27 MeV alpha, and Np-237 + 12.1 MeV deuteron. The dependence of the production ratio on angular-momentum deposition for the various reactions shows that the two shape isomers differ in spin with the short-lived component corresponding to the lower spin state. The experimental isomer ratios are compared with statistical model calculations. It is shown that, if a future threshold measurement demonstrates that the high spin isomer cannot decay to the low spin isomer, the deformation associated with shape isomerism can be deduced from isomer-spin information extracted from the present experiment and reference to the Nilsson diagram at large deformation. Author (NSA)

N71-22436# Purdue Univ., Lafayette, Ind. Dept. of Chemistry.
RADIOCHEMICAL INVESTIGATIONS OF NUCLEAR PROPERTIES Progress Report, Oct. 1969–Sep. 1970
Patrick J. Daly Sep. 1970 20 p refs
(Contract AT(11-1)-1672)
(COO-1672-21) Avail: NTIS

Research progress at the Purdue University Chemistry Dept. in the period Oct. 1969 to Sept. 1970 is reported. Some previously unreported data on Os-184,187 levels from Ir-184,187 decays, Hg-200 and Au-200 levels from Au-200m decay, and Re-185(p,n,photon) reactions are given. NSA

N71-22437# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
THE REACTION KAON(−) PROTON YIELDS ANTIKAON(0) PION(+) PION(−) NEUTRON AND THE GENERALIZED VENEZIANO MODEL
L. Gislen Feb. 1971 16 p refs Supported by DGRST, France and by the Swed. At. Council
(LPTHE-71/6) Avail: NTIS

A hybrid reggeized one pion exchange and generalized Veneziano model is applied to kaon(−) proton yields antikaon(0) pion(+) pion(−) neutron at 4.6 and 5 GeV/c and with small momentum transfers (n) less than or equal to 0.2 GeV2. With one parameter the model gives a good description of several experimental differential cross sections. Author

N71-22462# Brown Univ., Providence, R.I. Dept. of Physics.
SCATTERING OF ELECTROMAGNETIC AND GRAVITATIONAL WAVES BY A STATIC GRAVITATIONAL FIELD: COMPARISON BETWEEN THE CLASSICAL (GENERAL-RELATIVISTIC) AND QUANTUM FIELD THEORETIC RESULTS
Peter J. Westervelt 1970 18 p refs Sponsored by AEC
(NYO-2262-TA-222) Avail: NTIS

The classical general relativistic cross sections for the scattering of either an electromagnetic wave or a gravitational wave by a scalar particle are calculated and found to agree with the results of the quantized–linearized field theory. Author (NSA)

N71-22464# Laboratoire of Physique Theorique et des Hautes Energies, Orsay (France).
STRONG INTERACTIONS AND THE WEAK PARITY VIOLATING NUCLEAR POTENTIAL
D. Pignon Feb. 1971 11 p refs
(LPTHE-71/8) Avail: NTIS

The one-pion exchange weak, parity nonconserving, potential is calculated, taking into account the effect of strong interactions in the lowest order. The corrections are estimated and compared with the rho-exchange potential. Author

N71-22465 Florida State Univ., Tallahassee.
THE INFLUENCES OF VIBRATIONAL PERTURBATIONS ON ELECTRONIC TRANSITIONS IN SMALL POLYATOMIC MOLECULES
Phillip John Gardner (Ph.D. Thesis) 1969 159 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 70-6295

A comprehensive group theoretical study of all of the finite point groups and of two infinite point groups was undertaken in order to determine the extent of vibrational deficiency for various molecular geometries. Electric dipole selection rules were determined in order to ascertain possible examples of forbidden transitions in vibrationally deficient molecules. First order forbidden vibronic transitions are found to be physically possible in certain polyatomic molecules. A second electronic consequence of vibrational deficiency is predicted in small polyatomic molecules where missing antisymmetric vibrations may have a critical influence on the pathway of intramolecular radiationless processes. It is indicated that in vibrationally deficient molecules the electronic factor may have a significant influence on the nonradiative transitions. The fluorescence of SO2 from the second excited singlet state to the ground state is considered as a possible example of the influence of the electronic factor on radiationless processes in vibrationally deficient molecules. Dissert. Abstr.

N71-22520 Northwestern Univ., Evanston, Ill.
MOLECULAR BEAMS OF MACROIONS
Lawrence Lloyd Mack (Ph.D. Thesis) 1969 261 p
Avail: Univ. Microfilms: HC $11.95/Microfilm $3.40 Order No. 70-6493

The production of gas-phase, charged, intact polystrene molecules in the atmosphere was accomplished by using negatively charged, high voltage electrospray of solutions containing small quantities of high monodispersed polystyrene. The mechanism of such a technique is discussed in terms of the classical electrostatic pressure rupturing the solution into many tiny droplets. Because the solvent mixture is volatile, droplet evaporation takes place resulting in a chain of divisions of the polymer-carrying droplets into evan smaller daughter droplets. The end result of this process leaves the polystyrene molecule suspended in the N2 carrier gas with all or nearly all of the solvent stripped off of it and with only one or a few negative charges on the macroion. A positively charged, high voltage electrospray technique does not give the same end results as with negative polarity. The positively charged macroions are composed of clusters of charged polystyrene molecules in which the mass to charge ratio of the ion is dependent upon the concentration of polymer in solution. Dissert. Abstr.

N71-22521# Minnesota Univ., Minneapolis. School of Physics and Astronomy.
CONSISTENCY BETWEEN LOW ENERGY AND HIGH ENERGY HADRON SCATTERING: A BRIEF REVIEW OF SOME RESULTS OF DUALITY REGARDING INTERNAL SYMMETRIES
Jonathan L. Rosner (Tel-Aviv Univ.) [1969] 18 p refs Presented at The Eastern Theoret. Phys. Conf., Syracuse, N.Y. 10–11 Oct. 1970
(Contract AT(11-1)-1764; Grant EOOAR-0010-68)
(COO-1764-81; CONF-691033-2) Avail: NTIS

A brief review is given of some results of duality regarding internal symmetries for low- and high-energy hadron scattering. The quark model, superconvergence, finite-energy sum rules, and duality, exchange degeneracy and the quark model, and applications of quark graphs and duality are treated. NSA

N71-22522# Brookhaven National Lab., Upton, N.Y.
OPTIMUM PARAMETERS OF THE NEUTRON OPTICAL POTENTIAL FOR U 238
G. V. Anikin 1970 3 p Transl. into ENGLISH from At. Energ. (USSR), 1970 p 420–421 Sponsored by AEC
(BNL-tr-366) Avail: NTIS

An optical-model analysis is done for neutron elastic scattering by U-238 from 0.085 to 15 MeV. Energy-independent parameters are given which describe the total cross sections with accuracy of approximately 3% and the angular distributions with accuracy of 10 to 15%. NSA

N71-22523# Washington Univ., Seattle. Dept. of Physics.
VALIDITY OF THE SOPKOVICH APPROXIMATION
J. S. Blair Sep. 1970 30 p refs Sponsored by AEC
(RLO-1388-595) Avail: NTIS

Distorted-wave Born-approximation calculations for high-energy peripheral collisions are frequently circumvented by a simple

prescription, emerging from the high-energy WKB approximation, in which the plane-wave Born-approximation amplitudes are multiplied by the factors representing the phase shift characteristic of elastic scattering in the incident and final channels. The validity of this recipe for medium-energy nuclear reactions is tested through numerical calculations with a simple nonrelativistic potential model. For sufficiently weak potentials, the recipe appears quantitatively reliable; but in realistic situations of moderate or strong absorption, although it frequently approximates the exact angular distribution well, this prescription can given quantitatively unreliable values for the important partial-wave amplitudes as well as miss important features of the cross section. The implications of the numerical results for several related approximations are also discussed. Author (NSA)

N71-22524# GCA Corp., Bedford, Mass. Technology Div.
RECOMBINATION RATES OF THERMAL IONS Final Report, 17 Feb. 1969 - 16 Feb. 1970
Alexander Dalgarno and George A. Victor Dec. 1970 21 p refs
(Contract F19628-69-C-0168)
(AD-717774; GCA-TR-70-7-A; AFCRL-70-0551) Avail: NTIS CSCL 7/4

Detailed results are presented of a multi-state impact parameter calculation of the mutual neutralization process H(+) + H(-) yields H + H. Comparison is made with the experimental data over a wide range of energies and it is argued that the conventional interpretation of the process at thermal velocities in terms of avoided crossings is incorrect. It is tentatively suggested that the thermal behavior is due instead to a rotational coupling between molecular states of different symmetry. Author (GRA)

N71-22525# New England Inst. for Medical Research, Ridgefield, Conn.
PRELIMINARY STUDY ON THE TEMPERATURE EFFECT ON POSITRON ANNIHILATION IN KCIO(4)
S. J. Tao and S. Y. Chuang May 1970 6 p refs
(NYO-3661-33) Avail: NTIS

Positron annihilation in KCIO4 at temperatures from -196 C to 220 C was investigated. It was found that from -196 C to 100 C the mean lives of both the first and second component follow the relationship tau equals tau (0) + epsilon Tau. However, there is a sudden change at about 100 C. It can be a phase change or a second order transition. Further investigation is suggested. Author

N71-22550 Louisiana State Univ., Baton Rouge. Agricultural and Mechanical Coll.
A MODEL FOR CORRELATED MOLECULAR ROTATION
Lanny Max Casey (Ph.D. Thesis) 1969 109 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 70-9044

Correlated molecular rotations are studied with the aid of models which are representative of more complicated systems. The pertinent thermodynamic properties are calculated in an effort to determine the rotational contributions to these properties. A lattice gas model consisting of equally spaced hard molecules, represented by squares and arranged on a linear lattice, is considered first as the simplest model possessing rotational correlations. The molecules are allowed to rotate; the only force present is that due to the infinite potential of the hard core. A more general model is then considered to explore further the nature of the rotational contributions. The molecules are now allowed to translate while rotating, subject to an additional force attracting neighboring molecules. This model is approached from the standpoint of an isobaric partition function. Thermal properties, such as energy, heat capacity, and entropy, are also calculated to clarify further the effects of molecular rotation. Dissert. Abstr.

N71-22645 Princeton Univ., N.J.
NEW METHODS FOR PRODUCING HIGH ENERGY MOLECULAR BEAMS
J. B. Anderson and J. B. Fenn *In* AGARD New Exptl. Tech. in Propulsion and Energetics Res. Oct. 1970 p 403-422 refs (See N71-22626 11-12)
(Contracts Nonr-3623(00); AF 19(628)-3887; Grant NSF GK 655; Proj. Squid)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

Nozzle-beam operation and experiment design are reviewed. In particular, some of the differences between theory and practice will be discussed, and a number of useful relationships among the operating variables will be summarized. Author

N71-22646 Newcastle Univ. (England).
MEASUREMENTS OF VELOCITY AND DISSOCIATION IN SHOCK HEATED MOLECULAR BEAMS
D. Spence and K. Dolder *In* AGARD New Exptl. Tech. in Propulsion and Energetics Res. Oct. 1970 p 423-435 refs Sponsored in part by Min. of Technol. (See N71-22626 11-12)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

Shock-heated molecular beams of oxygen were produced. A mass spectrometer was used to measure the dissociation of oxygen in these beams and it was found that the measured dissociation increases smoothly and consistently with increasing shock strength. The measured dissociation is somewhat higher than that predicted by theory. This discrepancy between theory and experiment can be entirely explained if the cross section for dissociative ionization of oxygen by electron impact increases by a factor two when oxygen is heated to 3,500 K. Author

N71-22647 Queens Univ., Belfast (Northern Ireland). Dept. of Pure and Applied Physics.
MEASUREMENTS OF DISSOCIATIVE RECOMBINATION RATES IN PARTIALLY IONIZED GASES IN THE TEMPERATURE RANGE 1000 K TO 3000 K
J. N. Fox and R. M. Hobson *In* AGARD New Exptl. Tech. in Propulsion and Energetics Res. Oct. 1970 p 439-449 refs Sponsored in part by Min. of Aviation (See N71-22626 11-12)
Copyright. Avail: Technivision, Braywick, House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

A technique for the recombination rate measurements at elevated gas temperatures is described. A shock tube is used to provide a high temperature gas environment, at a precise and predetermined temperature, into which a limited volume of ionization is introduced by means of a microwave or RF pulse. The subsequent decay of ionization with time is related to the dissociative recombination coefficient and its variation with gas temperature determined in the case of argon. Problems of measurement, associated with metastable atom concentrations, are emphasized, and the possible effect of excited states of molecular ions on the temperature dependence in argon is discussed. Author

N71-22648 Universitaets-Sternwarte Goettingen (West Germany). Inst. fuer Physikalische Chemie.
MEASUREMENT OF RADICAL CONCENTRATIONS IN REACTING GASES USING ELECTRON SPIN RESONANCE
H. Koyermann and J. Wolfrum *In* AGARD New Exptl. Tech. in Propulsion and Energetics Res. Oct. 1970 p 451-465 refs (See N71-22626 11-12)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn: Mr. A. L. Candido)

To measure quantitatively atom concentrations with ESR, the influence of microwave power, saturation, and modulation amplitude on line width and first moment are studied. The results are applied mainly to elementary reactions whose rate constants and temperature dependence are determined with high accuracy. The flow system and sampling device employed are described. Author

N71-22649 Manchester Univ. (England). Dept. of Chemistry.
LOW PRESSURE DISCHARGE FLOW SYSTEMS AND THEIR APPLICATION TO THE CHEMICAL ASPECTS OF PROPULSION
H. F. Fountain and E. Hutton *In* AGARD New Exptl. Tech. in Propulsion and Energetics Res. Oct. 1970 p 467-479 refs (See N71-22626 11-12)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The discharge flow technique is described, and methods that were developed for the measurement of atom and radical concentrations are reviewed. Results relevant to combustion research applied to propulsion systems are discussed. The advantages and disadvantages of the technique are emphasized, and the precautions that were taken in the application of results to practical systems are pointed out. Author

N71-22650 Queens Univ., Belfast (Northern Ireland). Dept. of Pure and Applied Physics.
PROBE MEASUREMENTS OF CHARGED PARTICLE CONCENTRATIONS AND IONIZATION RELAXATION PHENOMENA IN LOW DENSITY SUPERSONIC GAS FLOWS
S. W. Radcliffe, T. I. McLaren, and R. M. Hobson *In* AGARD New Exptl. Tech. in Propulsion and Energetics Res. Oct. 1970 p 481/497 refs (See N71-22626 11-12)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The limitations on measurements conducted with probes in partially ionized low density supersonic gas flows are discussed. Experiments are described which relate some features of the probe response to interactions between the supersonic gas flow and the probe surface geometry. A preliminary theoretical formulation of the mechanism of charged particle collection related to the free stream ion/electron concentration is put forward. Measurements of thermal ionization rates in shock heated monotomic gases are given, and the initial reactions leading to ionization are determined and their cross sections measured. Author

N71-22696*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A FOCUSED CERENKOV RADIATION DETECTOR FOR PROTON BEAM ENERGY MEASUREMENTS
Sherwin M. Beck and Clemans A. Powell, Jr. Washington Apr. 1971 10 p refs
(NASA-TN-D-6194; L-7501) Avail: NTIS CSCL 20H

A focused Cerenkov radiation detection system has been developed and was used to measure the beam energy and energy spread of the nominal 600-MeV proton beam. The inherent resolution of the detection system was 4.2 percent full width at half maximum for the measured proton beam energy of 557.6 + or - 2.5 MeV. The energy spread of the proton beam was calculated to be 14 MeV full width at half maximum. Author

N71-22711# Air Force Cambridge Research Labs., Bedford, Mass. Research Library.
DISSOCIATIVE CHARGE TRANSFER REACTIONS OF He(+) AND Ne(+) IONS WITH N2, O2 AND CO2 MOLECULES AT COLLISION ENERGIES FROM 3 to 200 eV
H. Schlumbohm 19 Nov. 1970 13 p refs Transl. into ENGLISH from Z. Naturforsch. (Tubingen), v. 24A, no. 11, 1969 p 1720-1724
(AD-717690; AFCRL-70-0187; AFCRL-Trans-85) Avail: NTIS CSCL 7/4

Cross sections for the dissociative charge transfer reactions He(+) + N2, O2 and Ne(+) + N2, O2, CO2 were measured over an energy range from 3 to 200 eV and are compared with values given by other authors. The values were determined from measurements of the current of the slow charge exchange ions formed with a collision chamber. Author (GRA)

N71-22876 Princeton Univ., N.J.
THE KINETICS OF RADIATION DAMAGE IN KBr
Donald John Treacy (Ph.D. Thesis) 1969 157 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 70-8396

The efficiency of negative ion vacancy formation in KBr as a function of the temperature and the energy deposited in the lattice was measured between 6K and 300K. The structure of the curves generated was correlated with electronic and ionic processes occurring in various regions of temperature. No evidence was found of a temperature sensitivity of the efficiency which could be attributed to a changing ratio of radiative to nonradiative recombinations of holes and electrons V sub K centers. Evidence was found to support the conclusion that the ionization of electrons from shallow traps can enhance the efficiency of negative ion vacancy formation. The D sub 3-band, peaking at 268 nm, was found to display many of the properties previously attributed to the V sub 4-band. A V-type absorption peaking at 279 nm was resolved. No evidence of the V sub 4-band was found and it is suggested that many of the previous reports on the V sub 4-band may have been a mis-identification of the D sub 3-band. Dissert. Abstr.

N71-22882 Pennsylvania Univ., Philadelphia.
THE EFFECT OF SURFACE POTENTIAL VARIATION ON HIGH FIELD QUANTUM MECHANICAL TUNNELING
Satya Prakash Sharma (Ph.D. Thesis) 1969 194 p
Avail: Univ. Microfilms: HC $8.80/Microfilm $3.00 Order No. 70-7849

How a surface potential which has a periodic variation along the surface effects the high field quantum mechanical tunneling was investigated. Specifically, the effect of a potential which varies, both along the plane of surface and normal to the surface, on the field ionization at a specific crystallographic plane was considered. The analysis presented treats the ionization process as a three dimensional rearrangement collision. The surface is assumed to be a corrugated surface. This analysis has shown that a consideration of surface structure details, i.e., the potential variation in surface region and the corrugation in the surface does indeed lead to anisotropic tunneling probabilities on a given crystallographic plane. Since the image in the field ion microscope is produced by the ion current, this anisotropic tunneling probability can explain the bright spots and dark regions on the field ion micrographs. Dissert. Abstr.

N71-22971 Pittsburgh Univ., Pa.
NUCLEAR SPIN RELAXATION OF PROTONS IN ANTIFERROMAGNETIC CRYSTALS
Dennis William Whitson (Ph.D. Thesis) 1969 94 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 70-8631

Protonic spin-lattice relaxation-times were measured in antiferromagnetic NiCl2-6H2O (TN = 5.34 K) and CoCl2-6H2O TN = 2.29 K) in the temperature range 4.2 to 1.12 K. Spin-echo experiments were also carried out over the same temperature range to determine in homogeneous transverse relaxation time in NiCl2-6H2O and the extent of the inhomogeneous broadening in

CoCl2-6H2O. Samples of various impurities and shapes were investigated. The spin-lattice relaxation was found to be strongly temperature dependent for both crystals. The temperature dependence of spin-lattice relaxation in these two crystals along with the experimental results for CuCl2-2H2O are explained through a first-order two-magnon process plus a second-order three-magnon process. The second-order three-magnon process arises from the four-magnon exchange interaction. The impurity levels, the sample shape, and the orientation of an external magnetic field had no effect on the temperature dependence of spin-lattice relaxation. Dissert. Abstr.

N71-22972 Princeton Univ., N.J.
DETERMINATION OF THE INTERMOLECULAR POTENTIAL FROM SCATTERING DATA
Jay Coleman Knepper, Jr. (Ph.D. Thesis) 1969 142 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 70-8373

Calogero's equation for the phase of a wavefunction is used as the basis for the development of a flexible system for computing elastic scattering phase shifts. A numerical scheme is evolved in which either or both of JWKB and Born approximation may be used as adjuncts to the rigorous method during the course of calculating a single phase. Graphical illustrations of the form of potential sampling are presented and discussed. Phenomena arising in the scattering of identical particles are identified and examined using semiclassical methods including twinning interference in the differential cross section and the occurrence of fluctuations in the total cross section. Semiclassical arguments are used to derive bounds on the error in truncating the infinte series for the differential cross section. The inversion problem per se is considered with regard to the sensitivity of rainbow and glory scattering to small, localized changes in the potential, and with regard to the inversion of twinning data. Dissert. Abstr.

N71-22973 California Univ., Los Angeles.
BOSON THEORY OF ANGULAR MOMENTUM: HEISENBERG FERROMAGNETISM AT LOW TEMPERATURES
James Ivey Davis (Ph.D. Thesis) 1969 171 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 70-8130

The representation of angular momentum in terms of the boson operators originally introduced by Holstein and Primakoff is studied in detail. The correspondence between spin-deviation number in the spin space and occupation number in the boson is exploited to obtain boson representations of spin operators which satisfy the correct commutation rules and the correct representative equations for arbitrary states. Using only the proper parts of the spin operators, the possibility of constructing a hard-core model along the lines followed by Morita is investigated. Since the actual spin system cannot be excited into an improper state, it is argued that such states may be assigned infinite eigenvalue, and this physical condition is imposed by augmenting the Hamiltonian with a hard-core interaction. Dissert. Abstr.

N71-23018 Pennsylvania State Univ., University Park.
MASS SPECTROMETRIC INVESTIGATION OF COLLISIONAL IONIZATION BY ELECTRONICALLY EXCITED HELIUM ATOMS
James Joseph De Corpo (Ph.D. Thesis) 1969 176 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 70-7199

The methods of electron impact spectroscopy were used to obtain information on processes of chemi-ionization by electronically excited helium atoms. The reactions can be classified into two subgroups: (a) associative ionization, in which a neutral, electronically excited atom collides with a ground state atom or molecule to form a new molecular ion; (b) Penning ionization, in which ionization of another atom or molecule results on transfer of energy from the electronically excited atom. A theoretical calculation of the ionization efficiency curve of He2(+) is presented. This calculation is based on a proposed model and auxiliary data. The observation of the Penning Effect in the RPD curve by argon by metastable helium atoms is reported. The direct measurement of the rate constant for the Penning ionization process in argon by metastable helium is also reported. Dissert. Abstr.

N71-23028 Duke Univ., Durham, N.C.
A HIGH RESOLUTION STUDY OF THE SUSCEPTIBILITY OF LIQUID He 3
James Russell Thompson, Jr. (Ph.D. Thesis) 1969 91 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 70-8838

An accurate study of the nuclear susceptibility X of liquid He-3 was made. Particularly emphasized was the comparison of X with the Curie susceptibility x sub c. The results define a three dimensional surface x/x sub c versus temperature T and molar volume V between 0.35 and 2.2 K and 1.0 to 27.5 atmospheres. The measurements were accomplished using a carefully designed pulsed NMR set and sample-and-hold circuitry with a digital voltmeter for readout. Most of the measurements were made at fixed temperature relative to solid He-2, usually at a density of 22.50 cu cm/mole. The performance of the cryostat and electronics was verified by measuring the susceptibility of solid He-3 and finding the inverse temperature dependence expected form Curie's law. The results are estimated to be accurate within + or minus 0.5%. Dissert. Abstr.

N71-23031 City Univ. of New York.
LOW TEMPERATURE VOLUME EXPANSION OF LiH/LiT
Theodore Anthony Dellin (Ph.D. Thesis) 1969 100 p
Avail: Univ. Microfilm: HC $5.00/Microfilm $3.00 Order No. 70-3401

Crystals of LiH/LiT expand by self damage due to the beta decay of the T(-). At temperatures below 0 C the expansion is linear in the dose rate. Twenty-four defects in LiH/LiT were investigated theoretically. The formation energies of the defects and thr relaxations of the ions surrounding some of the defects are presented. A model for the low temperature volume expansion is derived. The T(-) ions undergo beta decay to form HeO atoms which recoil and collide with Li(+) ions to produce interstitial Li(+). The Li(+) then captures an electron from the beta decay to form LiO or Li2(+) which is sufficient to explain the observed volume expansion. Dissert. Abstr.

N71-23032*# Iowa State Univ. of Science and Technology, Ames.
MEASUREMENTS OF PION(-) PROTON ELASTIC SCATTERING FROM 1.71 TO 5.53 GeV/c
M. Fellinger, E. Gutman, R. C. Lamb, F. C. Peterson, L. S. Schroeder et al [1969] 23 p refs Sponsored in part by NASA and AEC Prepared in cooperation with Minnesota Univ., Minneapolis
(NASA-CR-117852; COO-1764-112) Avail: NTIS CSCL 20H

The pion(-) proton elastic scattering differential cross section was obtained at eighteen incident momentua from 1.71 to 5.53 GeV/c. The measurements were taken over a limited range of squared four-momentum transfer, t, near the forward direction. The statistical accuracy and resolution of these data are comparable to, or better than, existing data. The parameter b in the expression d sigma/dt = Ab to the bt power was determined at each of our incident momenta, and a large (approximately 25%) enhancement in b as a function of momentum is observed at a center of mass energy of approximately 2290 MeV. The relation of this bump in b with the well established bump in the total pion(-) proton cross section at approximately 2200 MeV is discussed. Author

N71-23034 Louisiana State Univ., Baton Rouge.
ENERGY BAND STRUCTURE OF FERROMAGNETIC NICKEL
Heh-Jeong Mo Zhang (Ph.D. Thesis) 1969 73 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 70-9108

Energy bands in ferromagnetic nickel were calculated using a modified form of the combined interpopulation (tight binding plus pseudopotential) method. The wave functions were based on the linear combination of atomic orbitals (LCAO) for d states and four plane waves for s states. The overlaps between all the basis states are explicitly considered. The tight binding integrals, computed for nickel, were employed in the tight binding part of the Hamiltonian. Spin orbit interaction has not been included. Pseudopotential parameters and a hybridizationparameter are included in the other part of the Hamiltonian. The parameters included in the Hamiltonian matrix were determined using experimental information. The Magneton number, density of states and some of the extremal cross sectional areas of the Fermi surface were calculated and compared with experiment. The Fermi energy was evaluated explicitly by counting the occupied states of all valence electrons (10 electrons/atom). Moderately good agreement with experiment is obtained. Dissert. Abstr.

N71-23035 Pennsylvania State Univ., University Park.
COULOMB EXCITATION OF Eu 151 AND Eu 153
Trevor James Lewis (Ph.D. Thesis) 1969 98 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 70-7225

Thick targets of natural europium metal were used to obtain excitation curves with 5 to 12 MeV alpha particles. Reduced transition probabilities were measured with 7 to 11 MeV alpha particles and 4.5 to 6 MeV protons. Pressed powder targets of Eu2O3 enriched to 97% in Eu-151 and Eu-153 were used to determine the isotopic origins of the observed transitions. A 2 × 2 inch NaI(Tl) spectrometer was used to study gamma rays of 800 to 2200 keV. In Eu-151, gamma rays of 111, 196.1, 244.0, 258.9, 286.1, 307.1, 476, 481.6, 502.9, 522.9, and 600.1 keV were found. Additional levels of 244.0, 600.1, and possibly 721 keV are proposed. A 383 keV transition in Eu-151 remains unassigned. In Eu-153, gamma rays of 83.3, 110.0, 151.5, 192.6, 486, 534.8, 568.9, and 617.1 keV were found. The 568.9 and 617.1 keV levels are tentatively interpreted as a 9/2(+) gamma vibration and a 5/2(+) beta vibration, respectively. Gamma rays of 76, 97.5, 175, and possibly 427 keV may originate in either Eu-151 or Eu-153. No transitions above 617.1 keV could be attributed to Coulomb excitation. Dissert. Abstr.

N71-23038 North Carolina State Univ., Raleigh.
RADIATION TRANSPORT IN PLANE AND SPHERICAL MEDIA
Owen James Smith (Ph.D. Thesis) 1969 143 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 70-9189

Exact solutions to the integral transport equations for the particle density are sought for several problems in spherical geometry. A transform technique is used in each case to reduce the integral equation to an integro-differential equation amendable to solution using Case's method of normal modes. The problems considered are: the finite medium shell source problem, the two region (concentric spheres) critical problem, in which a common total cross section is assumed, but different multiplication properties in the two zones are allowed, and the spherical Milne problem. Each analysis leads to an integral equation for the only unknown expansion coefficients, and these results were analyzed in the light of various approximations to the Fredholm equation. Dissert. Abstr.

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N71-22013# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PLASMA RESEARCH WITH LASERS [ISSLEDOVANIE PLAZMY S POMOSHCHUY LAZEROV]
L. A. Dushlin et al 20 Nov. 1970 132 p refs Transl. into ENGLISH from the Russian
(AD-717834; FTD-HC-23-593-70) Avail: NTIS CSCL 20/9

The development of optical quantum generators (lasers) with their high frequency stability, narrow beam and high power, has opened new prospects for the study of plasmas. At the present time, lasers are widely used in interferometric measurements to determine the spatial distribution of the electron concentration of plasmas. The theory of the measurement of density and temperature on the basis of light scattering by a plasma has been developed in detail, and the first experimental works have appeared. As the methods of studying plasmas with lasers are quite specific and promising, this book will make an attempt to summarize the principle theoretical results and experimental works. The book will be useful for physicists and engineers performing measurements on various plasma devices, as well as students and graduate students specializing in the area of plasma physics. GRA

N71-22117# Princeton Univ., N.J. Plasma Physics Lab.
MEASURING CURRENT DISTRIBUTION IN A TOKAMAK PLASMA
F. W. Perkins Dec. 1970 17 p refs
(Contract AT(30-1)-1238)
(MATT-818) Avail: NTIS

It is proposed to measure the current distribution in a tokamak plasma by measuring the (pitch) angle which the magnetic field makes with respect to the direction of a purely toroidal magnetic field, and then using Ampere's law. This measurement is carried out by observing the spectrum of CO2 laser light scattered by the plasma. As the difference between the incident and scattered wave vectors of the laser light approaches perpendicularity with the magnetic field, the spectrum changes qualitatively from the usual Gaussian spectrum to a series of sharp lines separated by the electron gyrofrequency. An angular resolution of approximately 0.5 degrees may be obtained. A feasibility study produces a signal-to-noise ratio of 80. Author (NSA)

N71-22164# Cornell Univ., Ithaca, N.Y. Lab. of Plasma Studies.
IONIZATION INSTABILITY IN THE PROPAGATION OF HIGH-CURRENT RELATIVISTIC ELECTRON BEAMS IN GASES
M. L. Andrews, H. Davitian, H. H. Fleischmann, and J. A. Nation Jan. 1971 14 p refs
(Contract N00014-67-A-0077-0003)
(AD-717399; LPS-63) Avail: NTIS CSCL 20/9

Measurements on electron beams propagating in a gas-filled drift tube show pressure dependent longitudinally periodic variations of light intensity, microwave emission, beam head velocity and net current. These results are consistent with an ionization instability, such as that proposed by Eastlund. Author (GRA)

N71-22166# Cornell Univ., Ithaca, N.Y. Lab. of Plasma Studies.
LABORATORY STUDY OF HIGH-BETA PLASMA SHOCK WAVES
David L. Morse and William W. Destler Jul. 1970 34 p refs
(Contract N00014-67-A-0077-0002)
(AD-717397; LPS-53) Avail: NTIS CSCL 20/9

A plasma wind tunnel has been used to generate shock waves at rest in the laboratory reference frame. The upstream pressure ratio beta is in the range 1 to 3, and the Mach number based on the fast magnetosonic wave speed is 3 to 5. The shock wave is formed by letting the plasma wind impinge on the field of a magnetic obstacle. The resulting shock is primarily transverse,

and exhibits a thickness of 1 to 1 1/2 times the ion inertial length (c/omega sub pi). The shock thickness decreases with increasing Mach number, and increases as the ion mass is increased. Magnetic fluctuations in the shock front are observed, with frequencies near the ion gyral frequency. Comparisons of these results with those of other experiments, and with the earths bow shock, are made. Author (GRA)

N71-22243# Aerospace Corp., San Bernardino, Calif.
SURVEY OF ELECTROSTATIC PROBE THEORIES
J. B. Fedele 20 Nov. 1970 61 p refs
(Contract F04701-70-C-0059)
(AD-717725; TR-0059(56816-42)-1; SAMSO-TR-71-3) Avail: NTIS CSCL 14/2

The dominant theories in existence for continuum electrostatic flush probes are reviewed and evaluated. Comparisons of theories with experiments are presented. Conditions for validity of the theories are presented, and applicable altitude ranges for reentry vehicle plasma flow field diagnostics are given. Spherical and cylindrical Langmuir (collisonless) probe theory and spherical continuum probe theories are surveyed. Current state-of-the-art industry efforts in electrostatic probe theory are described. Author (GRA)

N71-22248# Aerojet-General Corp., San Ramon, Calif.
ANALYTICAL AND DIAGNOSTIC RESEARCH IN HIGH TEMPERATURE PLASMA Final Summary Report
Oct. 1970 198 p refs
(Contract AF 33(615)-3927)
(AD-717723; AN-1665; ARL-70-0243) Avail: NTIS CSCL 20/9

The report consists of twelve self-contained papers on various aspects of analytical and diagnostic research in high temperature plasma. Author (GRA)

N71-22371# New York Univ., N.Y. Dept. of Electrical Engineering.
NONLOCAL REFLECTION IN A WARM PLASMA IN THE PRESENCE OF AN ELECTRON BEAM
Kyohei Sakuda Aug. 1970 116 p refs
(Contract N00014-67-A-0467-0018; Nonr-285(66))
(AD-717659; MEMO-M-9) Avail: NTIS CSCL 20/9

The document discusses in part A, the reflection mechanism of the longitudinal wave in an inhomogeneous plasma due to an external static electric field when an electron streaming beam is present and its direction is parallel with the external electric field. The reflection coefficient of the nonlocal effect is also calculated. Baldwin calculated the reflection coefficient due to inhomogeneity without streaming beam. But, most of the plasmas in laboratories have some kinds of streaming beams. Therefore, the result obtained here is a more realistic problem than Baldwins. Since the presence of the beam manifests itself in the exponent, the effect may be significant. In part B, the nonlocal reflection due to the presence of an electron streaming beam whose direction is perpendicular to the direction of the longitudinal wave is studied. It is obvious that the effect of an additional beam is very small, in other words, there is no synchronous region (or the resonant point) between the space charge wave and the plasma wave. Author (GRA)

N71-22433# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science.
THE INTERACTION BETWEEN A PLASMA FLOW AND A MAGNETIC NOZZLE WITH STRONG HALL EFFECT
Osami Okada and Kyoichi Kuriki Dec. 1970 46 p refs
(ISAS-457) Avail: NTIS

An experimental research on the interaction between a plasma flow and a magnetic field with nozzle-shaped lines of force was made with a large electron Hall parameter. The experiment was made using the plasma flow from a dc arc discharge and a magnetic field generated by a current loop. Measurements were made of the radiation emerging from the plasma flow, the number density of ions, the electron temperature, the impact pressure and the velocity of ions. The results showed that by the application of the magnetic field, the flow was strongly channelled and the electric field was induced in the flow. A theoretical analysis was made to explain the experimental results, using gasdynamic equations, generalized Ohm's law and Maxwell's equations. The theoretical results explained very well the mechanism of the interaction occuring upstream of the coil. The plasma flow was found to flow along magnetic lines of force. The magnetic nozzle, however, accelerated the ions to a higher velocity than that expected from the isentropic expansion. Author

N71-22442# Sandia Corp., Albuquerque, N.Mex. Scientific Translation Service.
A METHOD FOR INFRARED DIAGNOSTICS OF A PLASMA AND ITS APPLICATION FOR INVESTIGATION OF IONIZATION AND RECOMBINATION OF XENON BEHIND THE FRONT OF A SHOCK WAVE [METOD INFRAKRASNOY DIAGNOSTIKI PLAZMY I EGO ISPOLZOVANIE DLYA ISSLEDOVANIA IONIZATSII I REKOMBINATSII KSENONA ZA FRONTOM UDARNOY VOLNY]
N. A. Generalov et al 1970 26 p ref Transl. into ENGLISH from Zh. Eksp. Teor. Fiz. (USSR), v. 58, 1970 p 1928–1937 Sponsored by AEC
(SC-T-70-4054) Avail: NTIS

A method is described for determination of the electron temperature and electron concentration profiles behind the front of a shock wave. It is based on simultaneous measurement of emission and absorption by the ionized gas in the infrared region of the spectrum. Results of an experimental investigation of ionization and recombination processes in xenon at T = 8200 to 9200 K are presented. Good agreement between the experimental data and recombination theory based on a modified Fokker–Planck theory is obtained. Author (NSA)

N71-22443# Wisconsin Univ., Madison. Dept. of Electrical Engineering.
PLASMA INSTABILITIES AND WAVES EXCITED BY AN ANISOTROPIC ENERGY DISTRIBUTION PRODUCED BY ELECTRON CYCLOTRON RESONANCE Annual Progress Report
J. L. Shohet, J. C. Sprott, and S. R. Seshadri 15 Dec. 1970 133 p refs
(Contract AT(11-1)-1965)
(COO-1695-32) Avail: NTIS

The research involves the study of plasmas produced by electron cyclotron resonance heating in a magnetic mirror device. Specifically, the work has centered on: (1) measurement of the intensity and polarization of free–free bremsstrahlung from the plasma and the theoretical problem of relating the results to the electron energy distribution; (2) behavior of the plasma produced by cyclotron resonant heating when subjected to microwave radiation at a frequency displaced from the cyclotron frequency; both experimental and theoretical results have been obtained; (3) investigation and identification of an electromagnetic instability; and (4) numerical simulation and experimental diagnostic techniques used in conjunction with the above work. NSA

N71-22444# Innsbruck Univ. (Austria). Inst. for Theoretical Physics.
INVESTIGATIONS ON PLASMA INSTABILITIES Summary Report
F. Cap, G. Auer, D. Floriani, F. Herrnegger, and E. H. Jager 31 Dec. 1970 105 p refs
(Contract F61052-70-C-0014)
(AD-717751; UNICR-FR70; AFOSR-TR-71-0077) Avail: NTIS CSCL 20/9

The report summarizes the plasma research work during 1970 of the Institute for Theoretical Physics, Innsbruck University. The scientific part contains, among other things, the following items: Current research items and progress achieved within the frame of the U.S. project on plasma instabilities. The work on the stability behavior of hydromagnetic Poiseuille flows has been concluded. The new program aiming at a more satisfactory understanding of non-linear plasma phenomena has been initiated by extending the general and powerful concept of local thermodynamic potential to the stability analysis of MHD plasmas, and by re-examining the concepts of frequency and wave number as related to non-linear waves. The work on high-frequency oscillations in arbitrary plasma configurations has proceeded to the final stage of numerical evaluation of the general dispersion relation. Investigations into the field of Vlasov turbulence suggest that there might exist a close connection between the bunching phenomenon, trapped-particle modes, and turbulent heating. A comprehensive literature survey on plasma instabilities is being written. Courtesy report on the Austrian project. This project includes theoretical and experimental work on Q-machines, the numerical treatment of realistic MGD channel flow configurations, as well as the search for new solutions to the basic equations by means of similarity transformations. Author (GRA)

N71-22461# Wisconsin Univ., Madison. Dept. of Electrical Engineering.

PLASMA INSTABILITIES AND WAVES EXCITED BY AN ANISOTROPIC ENERGY DISTRIBUTION PRODUCED BY ELECTRON CYCLOTRON RESONANCE Quarterly Progress Report

J. L. Shohet and J. C. Sprott 15 Sep. 1970 53 p refs
(Contract AT(11-1)-1695)
(COO-1695-31; QPR-14) Avail: NTIS

The off-resonance heating phenomena have been studied in detail, both experimentally and theoretically. Bremsstrahlung measurements were made and compared with theoretical predictions. A new experimental facility has become operational, and studies of computer simulation of plasmas have continued. NSA

N71-22466# Cornell Univ., Ithaca, N.Y. Lab. of Plasma Studies.

THEORETICAL STUDIES ON ASTRON STABILITY Progress Report, 1 Jan. – 31 Dec. 1970

1970 180 p refs
(Contract AT(30-1)-4077)
(NYO-4077-1) Avail: NTIS

Various aspects of plasma physics experiments are reported. Subjects discussed are: (1) nonlinear beam plasma interactions and stochastic acceleration, (2) return current induced by relativistic beam propagating in magnetized plasma, (3) finite beta equilibria of relativistic electron beams in toroidal geometry, and (4) E layer precession in a plasma. Author

N71-22505# Massachusetts Inst. of Tech., Cambridge. Aerophysics Lab.

INITIAL EXPERIMENTS WITH ELECTROMAGNETIC ENERGY ADDITION TO A GAS BY A TRAVELING MAGNETIC FIELD Final Report, 1 Feb. 1968 – 15 Mar. 1970

Charles W. Haldeman, John P. Sullivan, and Hironori Takahashi
Wright-Patterson AFB, Ohio ARL Sep. 1970 131 p refs
(Contract F33615-68-C-1380)
(AD-717705; TR-165; ARL-70-0158) Avail: NTIS CSCL 20/9

Research on a traveling wave plasma accelerator for ultimate use as a high altitude, high velocity flow simulation device is reported. The research reported covers the design and final testing of an increasing phase velocity accelrator coil system and measurements of the performance of this system operating upon argon plasma at 1.6 torr static pressure and low supersonic Mach number. Impact and static pressure measurements indicate that the exit Mach number from the accelerator was increased from .7 without magnetic excitation to 1.5 with excitation at 126,000 ampere turns per meter (the power supply limit). Under these conditions the exit impact pressure increased from 2.8 to 4.8 torr, while the static pressure dropped from 2.0 to 1.6 torr. Design and testing of the high power accelerator coils using water cooled Litz cable is discussed, coils with quality factors (omega L/K) as high as 1200 being achieved. Water cooling ability of the coils was tested and a sample was successfully operated above the maximum design excitation of 600,000 ampere turns per meter. Minor developments of the RF plasma source are also discussed and a summary of a study of wave propagation in its nonequilibrium plasma is presented. Author (GRA)

N71-22516*# Oklahoma Univ., Norman. Dept. of Electrical Engineering.

MEASUREMENTS OF ELECTRONIC MEAN FREE PATHS IN ARGON PLASMAS

Leon W. Zelby [1970] 3 p refs Sponsored in part by NASA and NSF
(NASA-CR-117843) Avail: NTIS CSCL 20I

A plasma diagnostic technique has been extended to measurements of decay time of plasma and the determination of electronic mean free paths. The method is based on the measurement of the decay of the microwave signal propagating along a helix wrapped around the tube (1.25 cm inside diameter) containing the plasma. An argon discharge was employed using the interaction between the plasma electrons and a slow wave on a helix. The results compare favorably with available data. Author

N71-22560*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Propulsion Div.

LIQUID METAL MHD POWER CONVERSION

D. J. Cerini *In its* JPL Quarterly Tech. Rev., Vol. 1, No. 1 Apr. 1971 p 64 – 67 ref (See N71-22551 11-30)
Copyright. Avail: NTIS HC $6.00/MF $0.95 CSCL 20I

A liquid metal magnetohydrodynamic power converter has been successfully operated with the generation of ac electrical power. Gaseous nitrogen is used to produce the closed cycle flow of the liquid metal (NaK) working fluid through the MHD generator where the fluid kinetic energy is converted to electrical energy. The operational characteristics of the converter are given and the results of the current series of tests are discussed. Author

N71-22585*# Stanford Univ., Calif. Inst. for Plasma Research.

THEORETICAL AND EXPERIMENTAL STUDIES OF THE NATURE AND CHARACTERISTICS OF SPACE-RELATED PLASMA RESONANCE PHENOMENA Final Report, 1 Jul. 1969 – 30 Jun. 1970

F. N. Crawford Oct. 1970 42 p refs
(Grant NGR-05-020-077)
(NASA-CR-117844; SU-IPR-399; SAR-10) Avail: NTIS CSCL 20I

The space plasma experiments involving Alouette resonances, and the diagnostic techniques developed are discussed. Possible applications to the measurement of electron density and temperature, and local magnetic field strength are included. The exisence and mechanism of very long and delayed radio echoes was investigated as well as the resonant nonlinear interaction of two signals at frequencies omega 1, omega 2 to give a radiated signal at frequency omega 1 + or – omega 2. J.M.

N71-22639 Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Stuttgart (West Germany).

MEASUREMENTS WITH AERODYNAMIC PROBES IN PLASMA JETS PRODUCED BY ELECTROTHERMAL AND

HALL CURRENT ACCELERATORS

S. Krause *In* AGARD New Exptl. Tech. in Propulsion and Energetics Res. Oct. 1970 p 301–335 refs (See N71-22626 11-12)

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The measurement of macroscopic aerodynamic quantities in plasma jets which contribute largely in obtaining a better understanding of the phenomena in electric plasma accelerators is studied. A survey is given of early and recent experiments performed at the Institut fur Plasmadynamik, D.V.L., Stuttgart, with common and new types of aerodynamic probes. Radial distributions of Pitot pressure, stagnation enthalpy, mass and energy fluxes and other quantities in plasma jets emerging from electrothermal and Hall current accelerators are presented. A graphical iteration method is described for the determination of any thermodynamic values and the plasma velocity from the measured quantities. An interesting example shows the calculation of an unknown quantity by simultaneous use of aerodynamic and nonaerodynamic experimental results: the axial velocity in a Hall current accelerator is derived from aerodynamic yaw probe determination of the swirl angle and spectroscopic Doppler effect measurement of the azimuthal velocity

Author

N71-22640 Centre National de la Recherche Scientifique, Meudon (France). Lab. d'Aerothermique.

EXPERIMENTAL STUDY OF THE LAMINAR BOUNDARY LAYER WITH CATALYTIC REACTION OF THE WALL [ETUDE EXPERIMENTALE D'UNE COUCHE LIMITE LAMINAIRE FIGEE AVEC REACTION CATALYTIQUE A LA PAROI]

G. Lassau and E. A. Brun *In* AGARD New Exptl. Tech. in Propulsion and Energetics Res. Oct. 1970 p 337–355 refs In FRENCH; ENGLISH summary (See N71-22626 11-12)

Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The transformation of air components, due to the marked increase in temperature, during reentry is studied in the shock wave. It is assumed that there is an equilibrium flow in the shock layer, but the temperature in the vicinity of the wall is lower; chemical equilibrium no longer exists as the reaction time is too long in comparison with the residence time in the boundary layer; and the gas along the wall is in a metastable state. Experimental evidence of the catalytic effect of the flat wall parallel to the flow on the concentration in the boundary layer is given. The theory shows that from the concentration profiles in the layer, the wall concentration can be obtained. Concentration curves are obtained by three different methods: (1) By means of an enthalpy probe giving the activated nitrogen concentration in the boundary layer; (2) By injecting a carbide in the activated nitrogen and studying the luminosity; and (3) By mass spectrometry of cyanhydric acid. The three methods give similar results.

Author

N71-22651 Naval Postgraduate School, Monterey, Calif.

PLASMA DIAGNOSTIC TECHNIQUES

A. E. Fuhs *In* AGARD New Exptl. Tech. in Propulsion and Energetics Res. Oct. 1970 p 501–544 refs (See N71-22626 11-12)

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A family of instruments based on the magnetic-field-plasma interaction is discussed. A technique using microwaves to determine electron density profiles is discussed; the technique is in the conceptual stage. A diagnostic method based on excitation of electroacoustic waves is also discussed.

Author

N71-22652 California Univ., La Jolla.

INTERNAL PHYSICAL MEASUREMENTS IN MHD PLASMA ACCELERATORS

R. H. Lovberg *In* AGARD New Exptl. Tech. in Propulsion and Energetics Res. Oct. 1970 p 545–557 refs (See N71-22626 11-12)

(Contract DA-31-124-ARO(D)-257; Proj. Defender)

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A restricted set of correlated measurements is described, in which the electromagnetic field structure and the electron density distribution are determined, and inferences concerning the efficiency of acceleration and partitioning of electron and ion currents are made. The apparatus employed for this research is an inductive theta pinch. Electric and magnetic fields are measured by probes, and the electron density distribution is determined through a modified schlieren photographic technique. Current partitioning is inferred through insertion of the experimental data into the generalized Ohm's Law.

Author

N71-22653 Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Stuttgart (West Germany).

MAGNETOGASDYNAMIC PROPERTIES OF STATIONARY SUPERSONIC PLASMAJETS

J. Huegel *In* AGARD New Exptl. Tech. in Propulsion and Energetics Res. Oct. 1970 p 559–580 refs Sponsored by Bundesministerium fuer Wiss. Forsch. (See N71-22626 11-12)

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A device, similar to an arc-jet engine, was operated stably within a current range of 500 to 3000 amps at an ambient pressure of 0.5 mm Hg. With argon and nitrogen as working gases, mass flow rates of 0.075 to 0.6 g/s were applied. The velocity produced resulted from two mechanisms, aerodynamic acceleration due to heating and expansion processes and electromagnetic acceleration due to self-magnetic body forces. The relative importance of both effects is found to depend on arc current, mass flow rate, and electrode and nozzle configuration. A mean magnetic Reynolds number calculated from the experimental data exhibited a stronger than linear dependence on arc current and reached values of one at high currents.

Author

N71-22654 Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Stuttgart (West Germany).

ANALYSIS OF THE CURRENT FLOW OF A CONDENSER DISCHARGE OF AN ELECTRODELESS MHD MOTOR

A. Meert *In* AGARD New Exptl. Tech. in Propulsion and Energetics Res. Oct. 1970 p 581–592 refs (See N71-22626 11-12)

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A procedure based on a mathematical abstraction is shown to permit a very precise analysis of the current. Some procedures for the measurement of the discharge current are discussed.

Author

N71-22676*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EVALUATION OF AN ABNORMAL-GLOW DISCHARGE FOR USE AS A LABORATORY PLASMA SOURCE

Albert S. Roberts, Jr. (Old Dominion Univ.) and William L. Grantham Washington Apr. 1971 30 p refs

(NASA-TN-D-6136; L-6912) Avail: NTIS CSCL 20I

Abnormal glow discharge plasmas from both needle- and inverted-brush cathode configurations were studied for potential use

as laboratory test beds to develop and calibrate plasma diagnostic sensors. Electron densities of 10 to the 12th power electrons/cu cm were produced with short term variations of less than + or − 6 percent and long term (several months) repeatability better than + or − 15 percent. Measured plasma profiles are in good agreement with linear diffusion theory for uniformly spaced brush elements; however, an attempt to shape the steady state profile by tailoring the cathode distribution did not produce the theoretically predicted result. During tube warmup, some profile shaping was observed. Author

N71-22762 Tennessee Univ., Knoxville.
A NUMERICAL INVESTIGATION OF THE FREE EXPANSION OF A SUPERSONIC PLASMA JET HEATED AND ACCELERATED BY AN ELECTRIC ARC
Wolfgang Hermann Bergt (Ph.D. Thesis) 1969 159 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 70-7547

The steady state, axisymmetric flow field of the free expansion of a supersonic plasma jet issuing from a sonic orifice is investigated numerically using continuum flow theory. The gasdynamic flow of the plasma is influenced by a coaxial, electrical arc discharge, which is accomplished between a tipped cathode located upstream of the sonic orifice, and a coaxial, ring-shaped anode positioned some distance downstream of the orifice. The electrical discharge has two major effects on the plasma flow as a whole: the plasma is constantly heated during its supersonic expansion due to the effects of Joule-Heating and is accelerated due to self-induced Lorentz-Forces. The equations describing the problem are the conservation equations of mass, momentum and energy, as well as Maxwell's Field Equations supplemented by Ohm's Law. These equations constitute a coupled system of nonlinear, partial differential equations and the only possible approach of solving the given set of equations together with suitable boundary conditions is by means of the numerical method of finite differences. Dissert. Abstr.

N71-22771*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PROBING THE SOLAR PLASMA WITH MARINER RADIO METRIC DATA, PRELIMINARY RESULTS
P. F. Mac Doran, P. S. Callahan, and A. I. Zygielbaum *In its* The Deep Space Network, Vol. 1 15 Feb. 1971 p 14-21 refs (See N71-22766 11-30)
Avail: NTIS CSCL 20I

A radio technique, exploiting the opposite changes of group and phase velocity in a dynamic plasma, was used to probe the solar corona during the superior conjunctions of the Mariner 6 and 7 spacecraft. From an analysis of range and doppler radiometric data generated by the DSN in tracking the spacecraft, it was possible to establish a correspondence between plasma fluctuations in the radio raypath and McMath sunspot regions on the solar surface. Estimates of 3,000 electron/sq cm and scale sizes of 60,000 and 2 million km were made for plasma clouds transiting the radio path when tracking within a few degrees of the sun. Author

N71-22886 Tennessee Univ., Knoxville.
PROPAGATION AND DAMPING OF ELECTROSTATIC ION WAVES IN A PLASMA SUPPORTED BY A UNIFORM MAGNETIC FIELD
Akira Hirose (Ph.D. Thesis) 1969 67 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 70-7574

Electrostatic ion waves in a nonisothermal plasma supported by a uniform magnetic field were investigated experimentally and, in part, theoretically. Two major topics are included: Landau damping of ion acoustic waves due to electrons and contaminant ions and dispersion measurements of electrostatic ion waves propagating at arbitrary angles with respect to the magnetic field. Experiments were performed in a xenon plasma produced by a newly designed plasma source. Electron Landau damping of ion acoustic waves which is too small to observe in the absence of a magnetic field was demonstrated by letting the waves propagate almost across a relatively weak magnetic field. Dissert. Abstr.

N71-23082# Bari Univ. (Italy).
TRANSPORT PROPERTIES OF MIXED PLASMAS: He-N2, Ar-N2 and Xe-N2 PLASMAS AT ONE ATMOSPHERE, BETWEEN 5000 K AND 35000 K
M. Capitelli and E. Ficocelli 1970 55 p refs
Avail: NTIS

Numerical values of thermal conductivity, viscosity, and collision integrals are presented in tabular form for every 1000 K for compositions between 0 and 100% N2 at intervals of 10%. The methods of calculation and accuracy of results are described. Author

N71-23083# Bari Univ. (Italy).
EQUILIBRIUM COMPOSITIONS AND THERMODYNAMIC PROPERTIES OF MIXED PLASMAS. 2: ARGON OXYGEN PLASMAS AT 0.01-10 ATMOSPHERES, BETWEEN 2000 K AND 35000 K
M. Capitelli, E. Ficocelli, V. Molinari, and E. Molinari 1970 139 p refs
Avail: NTIS

Numerical results of equilibrium calculations for the argon-oxygen system at 0.01, 0.1, 1, and 10 atm are presented for every 1000 K and for compositions between 0 and 100% 02 at intervals of 20%. The species relevant to the system are 02, 02(+), 0, 0(+), 0(++), 0(−), Ar, Ar(+), Ar(++), Ar(+++), and e. There appears to be no evidence for the existence of gaseous negative ions other than 0(−). Author

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N71-21862 Northwestern Univ., Evanston, Ill.
THE CHEMICAL AND MAGNETIC STRUCTURE OF SINGLE CRYSTAL ALPHA MANGANESE
John Amiard Oberteuffer (Ph.D. Thesis) 1969 137 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 70-6512

The growth of small single crystals of alpha-manganese by a vapor deposition technique is described. These crystals with masses of several milligrams were found to be of high purity by atomic emission spectra analysis. X-ray measurements indicate the crystals have overall mosaic spreads of about .3 deg while relatively large regions of the crystals have mosaic spreads of less than .1 deg. The crystals have been used in magnetic torsion measurements at temperatures between 1.3 K and room temperature. The antiferromagnetic Neel transition is found at 96 deg + or − 1 K by the abrupt onset of two- and fourfold magnetic torques about [[100]] crystallographic axes which are observed down to 1.3 K. A predominantly fourfold magnetic torque below the Neel transition indicates the crystal consists of an isotropic distribution of magnetic domains. Dissert. Abstr.

N71-21939 Ohio State Univ., Columbus.
PREPARATION AND CHARACTERISTICS OF InAs FILMS GROWN BY COPLANAR CHEMICAL TRANSPORT
Carl Otto Bozler (Ph.D. Thesis) 1969 168 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 70-6731

An examination was made of all the possible film growing techniques, and the coplanar chemical transport system was chosen as having the best chance for growing high mobility indium arsenide films. The coplanar chemical transport system is fundamentally a chemical vapor transport process with the unique feature of having the source and substrate wafers in a parallel, horizontal, closely spaced configuration. This discovery is most useful because it combines the advantages of using a high resistivity high thermal conductivity substrate, like aluminum oxide ceramic, with the high crystal quality attainable with chemical vapor transport. The combination is also very economical, and as a result, the coplanar transport process has been further developed and is now being used for commercial production of thin film Hall generators. Dissert. Abstr.

N71-21941# Stevens Inst. of Tech., Hoboken, N.J. Cryogenics Center.

PROPERTIES OF SOLIDS AT LOW TEMPERATURES Final Report, 1 Apr. –30 Sep. 1970

John G. Daunt 5 Oct. 1970 42 p refs

(Contract Nonr-263(70))

(AD-717623) Avail: NTIS CSCL 20/12

The research programs discussed in the report are the following: Measurement of specific heats of H2 and D2 solid mixtures down to 0.5 degrees K; Measurement of adsorption isotherms of He3 and He4 at low temperatures; Development of a new He3 dilution refrigerator; and The development of a new type of He3 liquefier using Joule Thomson expansion. Author (GRA)

N71-21948 California Inst. of Tech., Pasadena.

ANISOTROPY AND CRYSTAL STRUCTURE OF FERROMAGNETIC THIN FILMS. 1. INVESTIGATIONS INTO MAGNETIC MICROSTRUCTURE BY LORENTZ MICROSCOPY

Tazao Suzuki (Ph.D. Thesis) 1969 238 p

Avail: Univ. Microfilms: HC $10.80/Microfilm $3.10 Order No. 70-569

The crystal structure of vacuum deposited Ni-Fe alloy films was determined over the composition range 5% to 85% Ni, with substrate temperature during deposition at various temperatures in the 25 to 500 C range. Uniaxial anisotropy field for 25% Ni-Fe alloy films deposited at temperatures in the range −80 C to 375 C was measured. Results indicate that the anisotropy is strongly sensitive to crystal structure and lead to the conclusion that pair ordering cannot be a dominant contributor. Width of the 180 deg domain wall in 76% Ni-Fe alloy films as a function of film thickness up to 1800 A was measured using the defocused mode of Lorentz microscopy. An experimental study of ripple by Lorentz microscopy was carried out. The following should be noted: (1) The only practical way to determine experimentally a meaningful wavelength is to find a well-defined ripple periodicity by visual inspection of a photomicrograph. (2) The average wavelength is of the order of 1 micron. (3) Experimental data confirm that the ripple structure results from the randomness of crystallite orientation and support the theory that the ripple amplitude is directly dependent on the crystalline anisotropy. Dissert. Abstr.

N71-21957*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

MAGNETIC FLUX FLOW IN A TYPE 2 SUPERCONDUCTOR

Eugene Willard Urban Washington Mar. 1971 74 p refs

(NASA-TN-D-6244; M-438) Avail: NTIS CSCL 20L

An experimental study was conducted to measure the flow of magnetic flux through the wall of a specimen of Nb-25%Zr, and thereby to infer the magnetic induction and currents in the material. It was found that if at some magnetic field the specimen were heated to above T sub c and recooled, and then if the applied field were subsequently changed at a constant rate, the rate of flux flow into or out of the sample would increase linearly with time. If measured at a series of magnetic fields, the rates of these increases, or the flow rate slopes, were found to be a smoothly increasing function of average applied field. Calculations based on eight published critical current density models did not satisfactorily explain these observations. It was found, however, that an empirical current density model did, in fact, give excellent agreement with the measured flow rate behavior. The experimental and analytical results are described and the new critical current density model is compared with earlier ones. Author

N71-21980# Harry Diamond Labs., Washington, D.C.

SHOCK INDUCED TRANSITION IN BARIUM TITANATE

Philip S. Brody Sep. 1970 28 p refs

(AD-717551; HDL-TR-1476) Avail: NTIS CSCL 20/12

Measurements on BaTiO3 ceramic were made of inverse dielectric constant versus uniaxial strain for values of strain ranging between -0.0043 and -0.013. The strain was produced in the region behind a shock front generated in a slab of the material by impacting it with a flying plate. The plate was accelerated in a gas gun. The slabs were disks with electrodes on the flat surfaces. The normal stress producing these strains ranged between 8.5 and 26 kbars. The dielectric constant was obtained from oscillograms of the shock-induced depolarization current through a circuit connecting the electrodes. A straight line was fitted to the curve of inverse dielectric constant versus strain. The slope of the line was -0.11 plus or minus 0.04. Thermodynamic theory was used to calculate this slope assuming the material was in the paraelectric phase for the range of experimental shock pressures. The calculated value was -0.13. The calculated value is in agreement with the experimental value and the assumption that the material is in the paraelectric phase for shock pressures between 8.5 and 26 kbars. Author (GRA)

N71-21983# Yeshiva Univ., New York. Belfer Graduate School of Science.

PHYSICAL PROPERTY OF THIN FLUIDS AND THE GLASSY STATE Interim Technical Report

D. Mattis, M. Goldstein, and M. Lipsicas Jul. 1970 100 p refs

(Contract N00014-69-A-0411)

(AD-717386) Avail: NTIS CSCL 20/12

A description is given of some of the ONR-supported recent work at Belfer Graduate School of Science in the fields of the theory of the insulator-metal transition; experimental aspects of the insulator-metal transition; and, the nature of glasses or amorphous solids. This includes results of some detailed calculations using the formalism of quantum statistical mechanics, results of experiments on thin films of magnetite and related materials, and studies of the relaxation processes and viscous flow in glasses, including metallic glasses. Author (GRA)

N71-22102 Tulane Univ., New Orleans, La.

THE MICROSTRUCTURE AND ELECTRICAL PROPERTIES OF THIN EPITAXIAL FILMS OF LEAD TELLURIDE

John Houston Myers, Jr. (Ph.D. Thesis) 1969 116 p

Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 70-6411

Epitaxial thin films of lead telluride were prepared by vacuum evaporation onto the (001) cleavage face of single crystals of sodium chloride. Substrate temperatures were varied from room temperature to 300 C, and deposition rates from approximately 100 to 1,000 A/min. Electron diffraction showed all the films examined to be strongly oriented with the (001) planes of the deposit parallel to the substrate. For a given set of deposition conditions the degree of departure from bulk behavior was found to be related to the film thickness, with the thinner films showing the larger decreases in temperature dependence. Such behavior is ascribed to

the scattering of carriers by the boundaries in the films. The spacing of the boundaries was calculated from the electrical data and a comparison of these with the spacings observed by electron microscopy showed a satisfactory quantitative agreement. Dissert. Abstr.

N71-22120# IBM Watson Research Center, Yorktown Heights, N.Y.

RESEARCH IN THE SYNTHESIS OF RARE EARTH COMPOUNDS AND A STUDY OF THEIR MAGNETIC OPTICAL AND SEMICONDUCTING PROPERTIES Semiannual Technical Report, 30 Jan. - 31 Dec. 1970

F. Holtzberg, T. R. McGuire, T. Penney, M. W. Shafer, and S. von Molnar 15 Jan. 1971 29 p refs

(Contract DAAH01-70-C-1309; ARPA Order 1588)

(AD-717369) Avail: NTIS CSCL 20/12

The report discusses the development of an understanding of the chemical equilibria involved in the synthesis and crystal growth of pure and doped europium chalcogenides. Also explored was the relationship of defect structures and dopant concentration to the magnetic, optical and transport properties of these materials. Since nonstoichiometry is a significant factor determining the physical properties of the chalcogenides, vapor-solid equilibrium in EuSe was investigated. A study of the reaction between H2S and Eu2O3 was carried out to determine the amount of residual oxygen in EuS as a function of reaction temperature. Magnetic measurements for the system Eu(1 - x)Gd(x)S over the range x = .03 to .36 show ferromagnetic properties with an increase in Curie temperature by a factor of three times over that of insulating EuS. Transport properties in both metallic and semiconducting europium chalcogenides are under investigation. In the former the effort is directed towards understanding the exchange interactions between conduction electrons and the localized spin of the rare earths. In the latter, the purpose is to distinguish between two basic transport processes, hopping and band conductivity. Author (GRA)

N71-22162# New Mexico Univ., Albuquerque. Bureau of Engineering Research.

ENERGY LEVELS IN THREE-DIMENSIONAL CRYSTALS

W. W. Byatt and Peter Chang Jan. 1971 32 p refs

(Contract N00014-68-A-0158)

(AD-717602; EE-180(71)ONR-005) Avail: NTIS CSCL 20/12

In the report the authors examine the question of energy levels in three-dimensional crystals. With the Schrodinger equation it became clear that the form of the crystal potential will affect the eigenvalue spectrum E. They therefore surveyed presently-used methods for the construction of the crystal potential. The eigenvalue spectrum, E, becomes a set of bands in a crystal. The authors also review methods used in the calculation of the energy band structure in solids. Finally they discuss the question of the energy band structure in crystals where there may be a random component of the potential present. Author (GRA)

N71-22163# Hewlett-Packard Co., Palo Alto, Calif. Solid State Lab.

MAGNETIC RARE EARTH COMPOUNDS Semiannual Technical Report, 1 Jun. - 30 Nov. 1970

R. A. Burmeister, T. L. Felmlee, and R. Hiskes Dec. 1970 81 p refs

(Contract DAAH01-70-C-1106; ARPA Order-1627)

(AD-717311) Avail: NTIS CSCL 20/2

A steady-state crystal growth system suitable for the growth of magnetic rare earth compounds has been designed, constructed, and successfully operated. A very stable solvent, consisting of BaO-B2O3-BaF2, has been developed. This solvent is nonvolatile and nonreactive, and is well suited to the solution growth of magnetic materials. Its unique qualities make it particularly advantageous for controlled epitaxial growth of mixed orthoferrites or garnets. The experimental solubility curve for XFeO3 indicates that 30 molar percent will dissolve at a typical crystal growth temperature of 1300C. Arrays of bubbles have been generated in YFeO3 grown in the BaO-B2O3-BaF2 solvent, and the coercivity and mobility of crystals grown from this solvent have been measured and found comparable to the best values for crystals grown in the PbO-based solvents. Lang topographic studies have revealed defects in YfeO3 which cannot be seen optically, and this technique is proving to be a very useful characterization tool. Author (GRA)

N71-22172# North Carolina State Coll., Raleigh.

ON HILL'S STRESS RATE IN THE CONTINUUM MECHANICS OF POLYCRYSTALS

Kerry S. Havner Dec. 1970 15 p refs

(Contract N00014-68-A-0187)

(AD-717326; TR-70-9) Avail: NTIS CSCL 20/12

The lattice co-rotational stress rate, suggested by Hill, is contrasted with the material co-rotational (Jaumann-Zaremba) stress rate and shown to be preferred in phenomenological continuum models of crystal behavior. A simple application to a crystal deforming via quasi-static single slip is included. Author (GRA)

N71-22182# Joint Publications Research Service, Washington, D.C.

ION BOMBARDMENT IN LATTICE DEFECTS AND SEMICONDUCTOR FABRICATION

9 Mar. 1971 33 p refs Transl. into ENGLISH from Fiz. Tekh. Poluprov. (Moscow), v. 4, no. 5, 1970 p 837-846 and from Izv. Vyssh. Uchеb. Zaved. Radioelektron. (Ukr. SSR), v. 13, no. 4, 1970 p 493-505

(JPRS-52565) Avail: NTIS

CONTENTS:

1. INJECTION OF 10-80 keV LITHIUM IONS INTO DIAMOND V. V. Galkin et al p 1-15 refs (See N71-22183 11-26)

2. ION BOMBARDMENT AS A METHOD OF FABRICATING MULTILAYER SEMICONDUCTOR P. V. Pavlov et al p 16-31 refs (See N71-22184 11-26)

N71-22183# Joint Publications Research Service, Washington, D.C.

INJECTION OF 10-80 keV LITHIUM IONS INTO DIAMOND

V. V. Galkin et al *In its* Ion Bombardment in Lattice Defects and Semiconductor Fabrication 9 Mar. 1971 p 1-15 refs (See N71-22182 11-26)

Avail: NTIS

Interference of light was used in investigating crystalline structure defects arising in diamond alloyed by injecting 10 to 80 KeV lithium ions at dose strengths in the range 10 to the 14th power to 10 to the 16th power sq cm. It was shown that the alloyed domain consists of two layers with different indexes of refraction, where the layer closest to the surface contains the bulk of the radiation defects. The thickness of the upper layer is determined by the mean free path of unchannelized ions. The thickness of the second layer is several times greater and is evidently associated with the mean free path of the channelized ions. High temperature treatment leads to annealing of defects for the case of low irradiation doses and to transformation of the severely damaged diamond domain into graphite when high irradiation dose strengths are used. The ionization region of the mean free path of ions can be observed in several sets of conditions. The measured profile of total conductivity is in agreement with interference measurements. Author

N71-22184# Joint Publications Research Service, Washington, D.C.

ION BOMBARDMENT AS A METHOD OF FABRICATING MULTILAYER SEMICONDUCTOR

P. V. Pavlov et al *In its* Ion Bombardment in Lattice Defects and Semiconductor Fabrication 9 Mar. 1971 p 16–31 refs (See N71-22182 11-26)
Avail: NTIS

The physical basis of alloying silicon by ion bombardment (IB) is presented. IB of silicon with boron and phosphorus ions at energies up to 200 KeV is shown to provide reproducible alloying and distribution of these impurities at depths up to 1 micron for specific conditions. Generalized families of boron and phosphorus distributions in a broad range of dose strengths and energies were obtained. These regularities afford realization of multilayer structures of different semiconductor devices. As an illustration, the formation of transistor structures by successive irradiation with boron and phosphorus ions is examined. The method of fabrication and the parameters of a planar p-n-p transistor made by a combination of IB and diffusion are presented. Author

N71-22247# International Business Machines Corp., Hopewell Junction, N.Y.
CRYSTAL PROPERTIES AS INFLUENCED BY CRYSTALLOGRAPHIC IMPERFECTIONS Final Report, Mar. 1968–Nov. 1970
Guenter H. Schwuttke Dec. 1970 19 p refs
(Contract F19628-68-C-0198)
(AD-717773; AFCRL-71-0024) Avail: NTIS CSCL 20/12

The principal objective was to study the defect properties of semiconductor materials as a function of impurity concentration and ionizing radiation. Of specific interest were micro-defects in silicon after ion implantation. The report summarizes the major results of the contract work and supplies a complete list of scientific reports, presentations and publications generated by this study. Author (GRA)

N71-22378# California Inst. of Tech., Pasadena. Keck (W. M.) Lab. of Engineering Materials.
SUPERCONDUCTING METASTABLE SIMPLE CUBIC ALLOYS
C. C. Tsuei, Huan-Chun Yen, and Pol Duwez Feb. 1971 4 p refs
(Contract AT(04-3)-822)
(CALT-822-22; Rept-17) Avail: NTIS

Four simple cubic superconducting alloys were obtained by rapid quenching (10 to the 7th power C/sec) from the liquid state: AuSb3, Pd(16.5)Sb(83.5), InSb3, and Au(1-x)Pd(x)Te2. Critical temperatures and lattice parameters are listed for these alloys and for previous experimental cubic alloys. NSA

N71-22395# Emmanuel Coll., Boston, Mass. Oriental Science Research Library.
GROWTH AND PROPERTIES OF SINGLE CRYSTAL MATERIALS FOR OPTO ELECTRONICS
Nobukazu Niizeki 29 Oct. 1970 33 p refs Transl. into ENGLISH from Oyo Butsuri (Tokyo), v. 38, no. 9, 1969 p 812–824
(Contract F19628-68-C-0251)
(AD-717684; EMM-70-254; AFCRL-70-0694; AFCRL-TRANS-88) Avail: NTIS CSCL 20/2

Single-crystal materials currently in the use in various fields of optoelectronics are reviewed from the viewpoint of materials science. The characteristics of crystal-line laser hosts, nonlinear optic crystals, electroptic crystals, and ultrasonic light diffraction solid media are described. The present status of crystal growth by the pulling method is discussed, and relations between the growth conditions and defects in the obtained crystals are stressed. The necessary steps in the process of device fabrication are analyzed, and some important factors such as phase diagram information, domain structure in oxide ferro-electrics, and laser damage susceptibility are pointed out. Some theoretical treatments of oxide ferroelectric crystals useful for materials scientists are reviewed. Author (GRA)

N71-22423# Rand Corp., Santa Monica, Calif.
THEORETICAL STRENGTH OF PERFECT CRYSTALLINE MATERIALS
Frederick Milstein Dec. 1970 43 p refs
(Contract F44620-67-C-0045)
(AD-717698; RM-6379-PR) Avail: NTIS CSCL 20/12

A mathematical procedure is presented for applying the Born stability criteria to the determination of the mechanical stability of cubic crystals in the presence of applied forces and deformations. The general procedure is suitable for use in conjunction with a computer and is independent of the specific model of interatomic interactions that can be used in numerical calculations. Specific calculations are performed for a body-centered cubic (B.C.C.) crystal lattice with a uniaxial tensile force applied perpendicularly to a face of a unit cell. The atoms in the crystal are assumed to interact through a 2-body Morse interatomic potential function appropriate to B.C.C. iron. Two ranges of stability are found to exist: a B.C.C. phase and body-centered tetragonal phase (B.C.T.). For the B.C.T. phase, the lattice remains stable for values of tensile strain up to about 7%, with corresponding strength. These values are close to the measured tensile characteristics of fine iron whiskers. Author (GRA)

N71-22500# Ohio State Univ., Columbus. Dept. of Metallurgical Engineering.
INVESTIGATION OF MIXED CONDUCTION IN SOLID ELECTROLYTES Progress Report, 1 Dec. 1970–30 Nov. 1971
Robert A. Rapp 30 Sep. 1970 20 p refs
(Contract AT(11-1)-1440)
(COO-1440-21) Avail: NTIS

Equilibrium and electrical conduction studies of the NaCl-TiCl$_x$ fused salt system are discussed. Chemical composition and conduction changes at various and fixed sodium activities are indicated. Included in the program are feasibility studies of a tracer technique to determine experimentally the solubility of hydrogen in several different solid oxide electrolytes in the temperature range of 800 to 1400 C. E.H.W.

N71-22884 Iowa State Univ. of Science and Technology, Ames.
BISTABLE RESISTIVITY SWITCHING PROPERTIES OF THE SEMICONDUCTING GLASS As-Te-Ge
Ronald Robert Uttecht (Ph.D. Thesis) 1969 85 p
Avail: Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 70-7757

The bistable resistivity switching in bulk samples of As-Te-Ge was found to correspond to the alternate formation and disruption of electrically induced conducting filaments. A method of forming and disrupting these filaments on the surface of the As-Te-Ge samples is presented which allows direct visual observation of the switching action. A cinematographic study was made of the relationship between filament formation and disruption and the changes observed in the electrical characteristics of the material. The stable transformation of the material to the low-resistance state depended on the formation of a continuous filament between two external contacts. Then the transformation back to the high-resistance state was accomplished by disrupting part of the filament. With all of the observations on the bistable resistivity switching process in As-Te-Ge as a basis, a model of the bistable switching mechanism in amorphous semiconductors is presented. Dissert. Abstr.

N71-22887 Baylor Univ., Waco, Tex.
PARTICLE SIZE EFFECTS IN DEBYE SCATTERING
Jimmy Jewell McCoy (Ph.D. Thesis) 1969 90 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 70-8020

Intensities were calculated from the Debye scattering equation for a face-centered cubic crystal (NaCl type) for cubic morphology.

with M atoms along each edge, for various values of M from 2 to 54, employing crystal symmetries to reduce the number of arithmetic operations. For M < or = 24 the relative intensities depend significantly upon particle size, varying in some cases as much as 50%. The intensity of the (200) peak is approximately proportional to M sup 4 with an accuracy of better than 5% for M > 4. A noticeable coherent background intensity was observed between maxima, approximately proportional to M sup 2 and amounts to more than 1% for M < 18. The Debye scattering equation was also applied to hexagonal crystals of the Ni(OH)2 and the graphite types, with hexagonal sheet morphology. Dissert. Abstr

N71-22889 California Univ., Los Angeles.
HETERODYNE DETECTION OF LIGHT SCATTERING FROM SOLIDS AT 10.6 MICRONS
William Ronald Cochran (Ph.D. Thesis) 1969 143 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 70-8242

An analysis is presented of the applicability of an optical superheterodyne detection system to the study of light scattering from acoustic modes in insulators and semiconductors. It is shown that since the signal-to-noise ratio obtained from such a system allows an absolute determination of the scattered spectral intensity, the elasto-optical constants of a sample crystal can be obtained directly, in addition to the elastic constants and the velocity of sound as a function of propagation direction. It is also shown that if radiation from a blackbody source is substituted for scattering from a crystal, the superheterodyne spectrometer provides a unique method for determining the quantum efficiency of photoconductors. A superheterodyne spectrometer has been constructed, utilizing a CO2 laser for the source of high-intensity 10.6 micron radiation, and a mercury-doped germanium photoconductor for the detecting element. Dissert. Abstr.

N71-22898 Oregon Univ. Eugene.
VIBRONIC ABSORPTION AND EMISSION SPECTRA OF F-CENTERS IN ALKALINE-EARTH OXIDES
Bruce Douglas Evans (Ph.D. Thesis) 1969 134 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 70-9429

The F-center in CaO is one of the few examples of a single electron defect center with a relatively small electron-lattice coupling so that many vibrational modes in both the absorption and emission spectra may be individually identified. A quantum treatment of the shape function governing this emission and absorption is developed in general and applied to the CaO F-center case in particular with mild success. The shape function, instead of being a sum of very closely spaced, quasi-continuous vibrational inner products, is now a finite sum of discernable vibrational overlaps. In particular, the absorption shape function is essentially a sum of the squares of the overlap of the (low temperature) ground electronic state zeroth order vibration H.O. was function with the first excited electronic state m th order vibrational H.O. wave function. For the F-center in CaO the sum need be carried no further than m approximately 15. The width of each vibronic transition is life-time broadened and is shown to be linear in m. Dissert. Abstr.

N71-22963 Purdue Univ., Lafayette, Ind.
EFFECTS OF ELECTRIC FIELD ON RECOMBINATION EMISSION AND FAR INFRARED EMISSION OF IMPURITIES IN InSb AND N-TYPE Ge
Stephen Neal Salomon (Ph.D. Thesis) 1969 206 p
Avail: Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 70-8964

The effect of an applied electric field on the photoluminescence of n- and p-type single crystal samples of InSb was studied at 4.2 K. The major emissions, given by electron-hole and electron-acceptor (0.075 eV ionization energy) recombinations decreased strongly when a field of about 1 to 5 V/cm was applied. The phonon-assisted electron-hole emission observed in n-type samples was not reduced by the field; the integrated intensity even showed an increase when the excitation light was not too strong. The n-type sample showed the electron-hole and electron-acceptor emissions. Additional observations and discussions are made on the shape of the electron-acceptor emission band with respect to excitation intensity, and the characteristics of photo-excited carriers. Far infrared recombination emission with wavelengths longer than 90 microns was observed under pulsed conditions from impurity breakdown in n-Ge(Sb) and p-InSb samples at 4.2 K. Dissert. Abstr.

N71-22981 Purdue Univ., Lafayette, Ind.
INVESTIGATION OF THE BAND STRUCTURE OF GALLIUM ANTIMONIDE USING THE SHUBNIKOV-DE HAAS EFFECT
David George Seiler (Ph.D. Thesis) 1969 149 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 70-8969

The Shubnikov-de Haas (SdH) effect was investigated in single crystals of n-type tellurium-doped GaSb. Field modulation and phase sensitive detection techniques were employed. The SdH period was found to depend on the magnetic field direction. At low magnetic fields, the Shubnikov-deHass oscillations are found to exhibit beating patterns which are related to magnetic field direction and the concentration of the samples. The results are in contrast to high field behavior in which only approximately exponential field dependence of the oscillatory amplitude has been seen. Recently calculated magnetic energy levels in an energy band with inversion asymmetry splitting show that the fundamental SdH amplitude is modulated by a function which depends on the interaction between the magnetic energy levels. This function accounts for the beating patterns observed in GaSb. The effect of hydrostatic pressures at liquid helium temperatures on the galvanomagnetic properties of GaSb was also investigated. Dissert. Abstr.

N71-23002 Princeton Univ., N.J.
A STUDY OF F TO M CENTER CONVERSION AND EQUILIBRIUM IN X-IRRADIATED KCl
Carleton Hoover Seager (Ph.D. Thesis) 1969 116 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 70-8390

Several types of experiments have been performed to elucidate the formation and destruction mechanisms for M centers in KCl. Crystals of Harshaw, lead doped, and zone refined KCl irradiated at 80K with 75kv X-rays were warmed up at 1/4K per minute while the concentration of F(2+) and M centers was periodically monitored. In addition, the temperature and X-ray intensity dependence of the F yields M equilibrium constant was measured over the range 200 to 400 K in X-irradiated crystals of these same three purities of KCl. Further experiments measuring the relaxation time for the approach to F yields M equilibrium after an X-ray intensity change were also performed. Dissert. Abstr.

N71-23043* Radio Corp. of America, Princeton, N.J.
METHOD OF ELECTROLYTICALLY BINDING A LAYER OF SEMICONDUCTORS TOGETHER Patent
Sidney G. Ellis, inventor (to NASA) Issued 6 Aug. 1968 (Filed 10 Nov. 1964) 5 p Cl. 136-89 Sponsored by NASA (NASA-Case-XNP-01959; US-Patent-3,396,057; US-Patent-Appl-SN-410330) Avail: US Patent Office CSCL 20L

A method is described for binding a layer of semiconductor particles by electrodeposition of an insulating film. The particles are floated on the surface of mercury, compacted by raising the level of the mercury, and then covered with an electrolyte; an electrode is inserted in the electrolyte while the mercury serves as the other electrode. The level of mercury is lowered depositing the layer on a base previously suspended in the mercury.
Official Gazette of the U.S. Patent Office

N71-23089 Princeton Univ., N.J.
PHYSICAL AND ELECTRICAL CHARACTERISTICS OF p TYPE SILICON ON SAPPHIRE
Edward Charles Ross (Ph.D. Thesis) 1969 205 p
Avail: Univ. Microfilms: HC $9.25/Microfilm $3.00 Order No. 70-8388

Hall effect measurements are presented for p-type silicon-on-sapphire films in the temperature range 77 to 300 K. Above 100 K, the hole mobility of films with acceptor concentrations between 3 × 10 to the 16th power/cu cm and 6 × 10 to the 17th power/cu cm is dominated by lattice scattering. The experimental data can be fitted by assuming a donor concentration of approximately 2 × 10 to the 14th power/cu cm in these films. Oxidation of p-type silicon-on-sapphire causes large changes in resistivity and impurity profiles. This is shown to be a result of preferential redistribution of the aluminum acceptors into the silicon dioxide surface layer. The diffusion constant of aluminum in silicon-on-sapphire is found to be two to six times greater than the diffusion constant of aluminum in bulk silicon. Prolonged oxidation causes a degradation of hole mobility. This is shown to be a result of the formation of precipitates of aluminum-oxygen complexes, which act as additional scattering centers. The mobility degradation is partially reversible by annealing at 1200 C in He for one hour.
Dissert. Abstr.

N71-23095# Air Force Cambridge Research Labs., Bedford, Mass.
INVESTIGATION OF THE SYNTHESIS OF DIAMONDS
Stanley Key Dickinson, Jr. 6 Nov. 1970 101 p refs
(AD-717691; AFCRL-70-0628; AFCRL-PSRP-434) Avail: NTIS CSCL 20/2

Crystals of high chemical and mechanical perfection are required for research in electronic devices. The purpose of the research reported here was to produce diamonds for use in the fabrication of semiconducting devices. This was one portion of a laboratory-wide program investigating the utilization of diamond as a high temperature semiconductor. Diamond synthesis is explained in terms of crystallization from a super-saturated liquid. The major driving force is thermodynamic. The primary condition for synthesis is a stable diamond-liquid equilibrium in which the liquid is composed of carbon and certain metal solvents. Thermodynamic expressions are developed for describing the pertinent portions of the nickel-, cobalt-, manganese-, and iron-carbon binary systems. Temperature-composition diagrams at high pressures are drawn to show stability relationships and the allowed limits for synthesis. The theoretical model is verified by an extensive ultrah-high pressure-temperature experimental investigation. Theoretical and empirical results are employed in predicting conditions for producing high quality single crystals.
Author (GRA)

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N71-22232# Naval Research Lab., Washington, D.C.
STATIC ELECTRICITY MEASUREMENTS DURING REFUELER LOADING Interim Report
Joseph T. Leonard and Homer W. Carhart 5 Jan. 1971 26 p refs
(AD-717347; NRL-7203) Avail: NTIS CSCL 21/4

The generation of electrostatic charge by JP-5-type jet fuel was examined at a truck fill stand which has both a 30-second relaxation chamber and bottom-loading capability. The installation, which is located at Patuxent Naval Air Station in Patuxent, Maryland, conforms to the latest NavFac design criteria except that a surge suppressor was not specified or provided. The objectives of the study were to examine the effect of hose diameter and length on the level of charge on fuel entering a refueler and to determine the effectiveness of the relaxation and bottom-loading facility in reducing the electrostatic hazard during refueler loading.
Author (GRA)

N71-22398*# General Dynamics/Convair, San Diego, Calif.
STUDY OF LOW GRAVITY PROPELLANT TRANSFER Quarterly Progress Report, 23 Sep.–22 Dec. 1970
J. A. Stark, K. R. Burton, J. M. Hazel, and J. L. Kramer 28 Dec. 1970 75 p refs
(Contract NAS8-28238)
(NASA-CR-103083; GDC-584-4-581; QPR-2) Avail: NTIS CSCL 20D

Research is reported in a program aimed at performing an analytical assessment of potential methods for replenishing the auxiliary propulsion, fuel cell, and life support cryogens aboard an orbiting space station. The detail definition and analysis tasks associated with modular transfer were essentially completed. The systems defined include shuttle systems, docking systems, and service systems. Three basic modes of operation were investigated. These modes were compared on the basis of weight, complexity, and operational requirements. The mode chosen contemplates empty dewar tanks loaded on the shuttle and filled during launch countdown. Various docking systems were also analyzed and compared. A triangular configuration for both the probe and receptacle was chosen as the most applicable. From the subsystems analyses a final overall modular tank system was defined.
D.L.G.

N71-22555*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Propulsion Div.
SOLID PROPELLANT BURNING RATE MODIFICATION
M. F. Humphrey *In its* JPL Quarterly Tech. Rev., Vol. 1, No. 1 Apr. 1971 p 29–34 (See N71-22551 11-30)
Copyright. Avail: NTIS HC $6.00/MF $0.95 CSCL 21I

Low acceleration is one of the requirements for solid propellant orbit insertion motors for future outer planetary missions. Described is the research accomplished in reducing the low pressure burning rates of modified solid propellant. Techniques developed with the saturated hydroxy-terminated polybutadiene system were successfully applied to the polyether system (JPL 540) and an unsaturated hydroxy-terminated polybutadiene propellant system. Burning rate reductions up to 50% were obtained by the synergistic effects of increased oxidizer size, reduction of iron, and inclusion of flame retardants and endothermic combustion modifiers.
Author

N71-22556*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Propulsion Div.
LOW ACCELERATION RATE IGNITION FOR SPACECRAFT
J. I. Shafer, L. D. Strand, and F. A. Robertson *In its* JPL Quarterly Tech. Rev., Vol. 1, No. 1 Apr. 1971 p 35–44 refs (See N71-22551 11-30)
Copyright. Avail: NTIS HC $6.00/MF $0.95 CSCL 21I

A g-dot ignition system for solid propellant motors has been designed to prevent damage to fragile sensors or structural members on a spacecraft by producing, from a starting transient for the spacecraft of 0.3 g, a controlled buildup in thrust, such as to give an acceleration rate of about 0.3 g/s. The system consists of a 3-s, regressive burning, controlled flow igniter and a highly inhibited progressive burning charge in the main motor. The igniter must operate in a hard vacuum and sustain burning of the uninhibited portion of the propellant below its normal combustion limit through mass addition and heat transfer until the propellant surface has increased sufficiently to provide a stable motor chamber pressure. A specific internal torus shaped igniter is described

along with its advantages and disadvantages as well as potential methods of initiating burning in the hard vacuum with Pyrofuze.
Author

N71-22883 South Carolina Univ., Columbia.
AN INVESTIGATION INTO THE MECHANISMS OF COMBUSTION OF A DOUBLE-BASE SOLID PROPELLANT
Charley Lewis Thompson, Jr. (Ph.D. Thesis) 1969 132 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 70-9317

Theoretical and experimental investigations of ignition and steady state deflagration of a double-base propellant were conducted. The values of parameters in the Arrhenius expression, describing chemical reactions in the solid, were determined by matching the numerical solution of the mathematical models with three sets of experimental data. The effect of thermal radiation was shown to be only thermal and the effect on the steady deflagration of M-2 propellant was shown to be insignificant. The experimental measurements of the temperature profiles over the pressure range of 1 to 115 psia showed that the gas close to the deflagrating solid contains a series of distinct reactions. The occurrence of these reactions was shown to depend on pressure and time. These reactions approached the solid-gas interface as pressure increased. The rather erratic behavior of some isobaric burning rates with increase of initial temperature of the propellant was theoretically verified to be the consequence of the thermal interaction between the solid and the reactions. Dissert. Abstr.

N71-22951 Imperial Coll. of Science and Technology, London (England).
EXPERIMENTAL STUDIES OF EFFECTS OF TROPOSPHERIC AIR MASS MOVEMENTS ON UHF TRANSMISSIONS USING A LABORATORY MODEL
W. G. Burrows *In* AGARD Phase and Freq. Instabilities in Electromagnetic Wave Propagation Jul. 1970 p 653–657 refs (See N71-22901 11-07)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

A laboratory scale model is described as a means by which the effects of macroscopic air mass movements on UHF transmissions in the troposphere may be investigated. Some simple examples of the types of result obtainable on such a model are given to indicate and confirm the extent of these effects on the level of a received signal at a distant receiver aerial displaced from the axis of the main beam of a transmitter aerial. The preliminary results of a laboratory study indicate that there is close correlation between the characteristics or shapes of transmission loss versus time recordings over a given path and different types of air mass movements created along the same path. This implies that similar relationships may be true for the full scale tropospheric path.
Author

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magneto-hydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N71-22010*# McDonnell-Douglas Astronautics Co., St Louis, Mo.
SPACE SHUTTLE LOW PRESSURE AUXILIARY PROPULSION SUBSYSTEM DEFINITION Summary Report
P. J. Kelly and T. F. Schweickert 29 Jan. 1971 62 p refs (Contract NAS9-11012)
(NASA-CR-114945; MDC-E0293) Avail: NTIS CSCL 22B

An overview is presented of a study to define the most attractive low pressure, oxygen/hydrogen auxiliary propulsion subsystem (APS) for NASA space shuttle boosters and orbiters. A conceptual subsystem definition phase designed to identify APS concepts best suited to each of two baseline shuttle boosters and orbiters is presented with a preliminary design of selected subsystems to establish indepth understanding of subsystem design and operation. Conceptual subsystem definition studies have shown that a low pressure APS can potentially fulfill shuttle requirements, and that such as APS is simple in design and operational approach. The most attractive low pressure concepts use the main engine propellant tanks as low pressure gas accumulators. Propellant residuals trapped in the main engine tanks following boost are sufficient to meet booster APS propellant demands. The booster APS operates as a simple blowdown subsystem and no additional control is required. The orbiter requires separate liquid propellant storage tanks to supplement boost residuals. Propellant from the storage tanks is circulated through passive, tank-mounted heat exchangers where it is superheated and injected into the main engine tanks. Warm propellant vapors from the main engine tanks are mixed with additional liquid propellants in a downstream liquid/vapor mixer, and supplied to the engines at constant temperature and pressure (constant density). Author

N71-22376# Newcastle Univ., (Australia). Dept. of Physics.
RIOMETER STUDIES OF THE INTERRELATIONS OF RADIO NOISE AND ABSORPTION Final Report, 1 May 1969–30 Apr. 1970
Clifton D. Ellyett and Ronald H. Roberts Jul. 1970 15 p refs (Grant AF-AFOSR-1793-69)
(AD-717792; AFOSR-70-1993TR) Avail: NTIS CSCL 20/14

Tentative riometer data recorded at Christchurch, New Zealand, during 1960-61 indicated that cosmic noise absorption measurements sometimes appeared to show a gradual increase for one or two days prior to a major flare. The hypothesis was made that a possible cause could be a slow increase in solar X-ray activity. Since 1966 accurate riometer studies have been made at Newcastle, N.S.W., Australia. It would appear, from recent satellite data, that there is, at least in a number of cases, a slow build-up of solar X-ray emission prior to a significant flare. Any associated absorption changes measured at mid-latitudes, however, are so slight that it calls for almost impossibly high riometer stability. A more useful indicator is likely to be the continuous direct satellite monitoring of solar X-ray emissions. Observations are being continued with an extensive aerial array giving a narrow beam, with negligible side lobes, tilted electronically south of the zenith to exclude direct solar noise. Author (GRA)

N71-22460# National Aerospace Lab., Tokyo (Japan).
A STUDY OF GIMBAL ENGINE ACTUATING HYDRAULIC SERVOMECHANISM WITH DPF HYDROMECHANICAL COMPENSATION NETWORK
Shigeki Hatayama and Hajime Koshiishi Sep. 1970 47 p refs In JAPANESE; ENGLISH summary
(NAL-TR-213) Avail: NTIS

One of the most important problems associated with the design of liquid rocket thrust vector controlling systems is compensation of resonances, which arise from mechanical compliance in gimbal-engine mechanisms. Dynamic Pressure Feedback compensation is appropriate for this problem. The design effort on the gimbal-engine actuating hydraulic servo with DPF hydromechanical compensation network, which realizes DPF compensation characteristics is presented. The experimental device showed that a DPF hydromechanical compensation network functions well to compensate for the resonance of gimbal-engine mechanisms. An analog computer-hardware simulation of rocket pitch attitude

control system by the gimbal-engine is presented to illustrate the effectiveness of a DPF compensation hydraulic servomechanism. Author

N71-22503# Aeronautical Research Labs., Melbourne (Australia).
THE GOBLIN Mk35 ENGINE: INVESTIGATION OF NOISE AND VIBRATION
J. E. Williams and D. H. Edwards Apr. 1970 87 p refs
(ARL/ME-127) Avail: NTIS

Some Goblin Mk 35 engines in R.A.A.F. service developed unusual noise and vibration in flight at altitudes above about 17,000 feet. An investigation showed that the noise and vibration were caused by unstable airflow in the engine, which resulted in pressure pulsations in the combustion system. The instability was found to originate in the compressor vaneless diffuser space under conditions of high internal Mach Number which occurs at high engine speed and low inlet air temperature. While the cause of the instability was not determined precisely, evidence indicated that it was probably caused by boundary layer flow separation on the rear wall of the vaneless diffuser space. The compressor modification which gave rise to the instability increased the radial depth of the vaneless space, potentially decreasing the stability of the boundary layer flow; the actual occurrence of instability depended upon the air flow distribution around the engine. The disturbance was shown to have no effect upon the mean performance, and to present no hazard to the safe operation of the engine. Some alleviation of the condition was shown to be possible by engine nozzle area modification to increase the engine airflow, and by modifications designed to improve the uniformity of airflow distribution around the engine. Author

N71-22613*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LOW-FREQUENCY PLASMA NOISE FROM THE ELECTRON-BOMBARDMENT ION THRUSTER
Allan J. Cohen Washington Apr. 1971 26 p refs
(NASA-TN-D-6286; E-6053) Avail: NTIS CSCL 21C

Low frequency plasma noise from a mercury electron bombardment ion thrustor was studied for several magnetic field configurations. Frequency spectra of the plasma noise were recorded from the operating thrustor and a correlation study comparing probe separation with signal time delay was made. A critical magnetic field was determined from ion chamber performance and relative plasma noise measurements. Rotation of the plasma noise was found from the correlation study with a direction of rotation determined by the magnetic field direction. Correlation of the plasma noise along field lines was also observed with no time delay. A cusp magnetic field in only a portion of the discharge chamber was found to suppress plasma noise but no improvement of thrustor performance was observed. Author

N71-22614*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
AN INVESTIGATION OF TWO VARIATIONS OF THE GAS GENERATOR METHOD TO CALCULATE THE THRUST OF THE AFTERBURNING TURBOFAN ENGINES INSTALLED IN AN F-111A AIRPLANE
Frank W. Burcham, Jr. Washington Apr. 1971 30 p refs
(NASA-TN-D-6297; H-643) Avail: NTIS CSCL 21E

Two variations of the gas generator method for calculating the net thrust of the afterburning turbofan engines installed in an F-111A airplane are investigated. An influence coefficient study and two ground thrust tests were performed. It was found that the gas generator method can be successfully applied to an afterburning turbofan engine. At static conditions with two engines operating, + or − 2 percent accuracy can be achieved for most power settings using either the method based primarily on nozzle total pressure and area (PTA) or the method based primarily on nozzle total temperature and weight flow (TTW). For in-flight conditions the influence coefficient results indicated that the accuracy of the TTW method was about + or − 3 percent, whereas the accuracy of the PTA method was about + or − 5 percent for a military power setting. With either calculation method, additional errors in calculated thrust of + or − 2 percent could result from high inlet flow distortion. If accurate thrust values are required, both thrust calculation methods should be used. Author

N71-22689*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HIGH TEMPERATURE TURBINES
Jack B. Esgar and R. A. Reynolds (Dept. of Ind., Trade, and Com., Ottawa) Paris AGARD Feb. 1971 7 p refs Presented at the 36th Meeting of the Propulsion and Energetics Panel, Florence, 21–25 Sep. 1970
(NASA-TM-X-67123; AGARD-AR-29-71) Avail: NTIS CSCL 21E

State of the art review of high temperature turbine technology was provided at this conference. The following topics were covered by papers presented: problems involved in cooling small turbines, application of turbine blade cooling to engines, selection of high temperature and cooled turbine materials, heat transfer measurement techniques, and an evaluation of the techniques of film, convection, and transpiration cooling. E.M.C.

N71-22983* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
CONTINUOUS DETONATION REACTION ENGINE Patent
Oswald H. Lange, Richard J. Stein, and Harold E. Tubbs, inventors (to NASA) Issued 22 Aug. 1967 (Filed 21 Mar. 1966) 5 p Cl. 60-258
(NASA-Case-XMF-06926; US-Patent-3,336,754; US-Patent-Appl-SN-537615) Avail: US Patent Office CSCL 21H

A detonation reaction engine is described having an outer housing enclosing a pair of inner walls that form a continuous channel. The channel has one open side and forms a chamber in which a continuous detonation reaction is generated. The inner walls have injector ports formed therein through which fuel and oxidizer are injected to form impingement points of fuel and oxidizer at spaced intervals around the channel. One of the impingement points is initially detonated by a detonation wave generating apparatus and thereafter the reaction is continuous and self-sustaining. Official Gazette of the U.S. Patent Office

N71-23081* Hughes Aircraft Co., Culver City, Calif.
CONSTRUCTION AND METHOD OF ARRANGING A PLURALITY OF ION ENGINES TO FORM A CLUSTER Patent
Hayden E. Gallegher, inventor (to NASA) Issued 6 Feb. 1968 (Filed 8 Oct. 1965) 5 p Cl. 60-202 Sponsored by NASA
(NASA-Case-XNP-02923; US-Patent-3,367,114; US-Patent-Appl-SN-494280) Avail: US Patent Office CSCL 21C

A system is devised for positioning a plurality of ion engines, one upstream of the other to form a cluster rather than in side by side relationship. Such a construction decreases the amount of heat radiated to space by each ionizer's surface since it is shielded by a down-stream engine. The ion engines are additionally insulated by radiation shields encircling the engines. This also decreases the heat radiated to space to further increase the efficiecy of the group of engines. Further, when the engines are positioned in a line with a common longitudinal axis, it is easier to control the thrust if one engine should become inoperative since the direction of thrust of the remaining engines would still continue to be along their common longitudinal axis. E.M.C.

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N71-22043# Israel Program for Scientific Translations, Ltd., Jerusalem.

COMPUTATION OF SOLAR RADIATION CHARACTERISTICS

S. I. Sivkov 1971 192 p refs Transl. into ENGLISH of the book "Metody Rascheta Kharakteristik Soln. Radiats." Leningrad, Gidrometeorologicheskoe Izd., 1968 192 p Sponsored in part by ESSA and NSF

(TT-70-50055) Copyright. Avail: NTIS

Methods and techniques for computing individual components of the radiation regime to determine the solar heat budget in the earth's atmosphere are discussed. The general law of atmospheric attenuation of solar radiation, and the specific results of absorption and scattering are described. Radiation intensity is calculated for a cloudless atmosphere from optical density and liquid water content and from direct measurements. Daily radiation totals and transparency characteristics of the cloudless atmosphere are also computed. The effects of cloudiness on short wave radiation fluxes and on the duration of sunshine are determined, and estimates of visual cloudiness are used to obtain true radiation totals. N.E.N.

N71-22114# New Industrial Concepts Ltd., London (England).

TD-1 S59 BAFFLE SYSTEM Interim Report

A. Boksenberg, F. W. Bullock, M. J. Esten, D. R. Flower, and G C. Green 27 Nov. 1970 32 p

(Contract ESTEC-1045-70-GW)

Avail: NTIS

The required attenuation at the bottom of the TD-1 satellite baffle box, including the attenuation of the spacecraft baffle, is specified as 10 to the 8th power in terms of incident solar flux at full aperture, and applies to the tracking channel, not the spectrometer channels. The performance of the modified S59 baffle system, with modified spacecraft baffle, is computed for the attenuation of photospheric sunlight and moonlight to obtain an initial assessment of the adequacy of the new system. Author (ESRO)

N71-22122# New Industrial Concepts Ltd., London (England).

TD-1 S2/68 BAFFLE SYSTEM Interim Report

A. Boksenberg, F. W. Bullock, M. J. Esten, D. R. Flower, G. C. Green et al 13 Jan. 1971 33 p refs

(Contract ESTEC-1045-70-GW)

Avail: NTIS

The required attenuation for sunlight at the S2/68 photometer channel in the TD-1 satellite, in terms of incident sunlight at full aperture, is specified as greater than 10 to the 15th power. The implied attenuation for the spectrometer channels is much greater still than this. The performance of the new S2/68 baffle system, with new spacecraft baffle as appropriate, is computed for the attenuation of photospheric sunlight and moonlight to obtain an initial assessment of their adequacy. Author (ESRO)

N71-22413*# Israel Program for Scientific Translations, Ltd., Jerusalem.

X-RAYS, GAMMA RAYS, ELECTRONS AND NEUTRINO

G. E. Kocharov et al *In its* Proc. of the Sixth Winter School on Space Phys., Part 1, 1971 p 109-197 refs (See N71-22411 11-30)

Copyright. Avail: NTIS HC$6.00/MF$0.95 CSCL 03B

Experimental data on gamma ray and X-ray radiation from outer space are described, and it is noted that there is no common opinion on their origin. Experimental measurements were also made of the spacial and spectral distribution of low energy gamma rays from space. Neutrino experiments on accelerators and neutrino emission from the sun are described. Satellite observations of X-ray and gamma rays, electron cosmic ray component in the upper atmosphere, and the differential rotation nonsphericity of the sun's surface are also considered. N.E.N.

N71-22414*# Israel Program for Scientific Translations, Ltd., Jerusalem.

PHYSICS OF THE SOLAR ACTIVITY AND DYNAMIC PROCESSES IN THE INTERPLANETARY SPACE AND IN THE EARTH'S MAGNETOSPHERE

S. N. Vernov et al, ed *In its* Proc. of the Sixth Winter School on Space Phys., Part 1 1971 p 199-332 refs (See N71-22411 11-30)

Copyright. Avail: NTIS HC$6.00/MF$0.95 CSCL 03B

Papers on magnetospheric, solar, interplanetary space, and plasma physics are presented. Interplanetary electric and magnetic fields, proton fluxes, plasma, and space radiation are discussed. Solar protons, wind, and activity were studied and radar astronomy of the sun is described. The relation between magnetospheric electric fields and the earth's rotation, magnetic storm development in the magnetosphere, interactions in the magnetosphere tail, and distribution of the outer belt protons are studied. Plasma containment in adiabatic traps, self-similar flow in rarefied plasma, particle acceleration in plasmas, and structures in ionized stellar and planetary atmospheres are also investigated. N.E.N.

N71-22417*# Israel Program for Scientific Translations, Ltd., Jerusalem.

GENERATION, ENERGY SPECTRUM, VARIATIONS AND PROPAGATION OF COSMIC RAYS

S. N. Vernov, ed., et al *In its* Proc. of the Sixth Winter School on Space Phys., Part 2 1971 p 33-93 refs (See N71-22415 11-30)

Copyright. Avail: NTIS CSCL 03B

Studies of solar and galactic cosmic rays are discussed. Cosmic ray acceleration and propagation, energy spectrum, diffusion coefficients, radiation variations and correlation to solar activity, and meteoric variations are described. Relativistic electron and neutron components, ultrahigh energy cosmic rays, and different geomagnetic field theories are considered. N.E.N.

N71-22420# Arkansas Univ., Fayetteville. Dept. of Chemistry.

ATMOSPHERIC RADIOCHEMISTRY Annual Progress Report

P. K. Kuroda 31 Dec. 1970 169 p refs

(Contract AT(40-1)-2529)

(ORO-2529-28) Avail: NTIS

Research progress is documented in nine appendices: (1) temporal distribution of radioactivity and Sr-89/Sr-90 ratios during rainstorms, (2) jet stream and radioactive fallout, (3) radiocerium isotopes ratio variation in rain due to Chinese thermonuclear explosion, (4) Sr-89 and Sr-90 levels in rain at Fayetteville, Arkansas from September 1969 to August 1970, (5) similar data in air from August 1969 to July 1970, (6) Be-7 levels in rain at Fayetteville, (7) radiochemical studies on Cs-137 in rain, (8) early fallout studies of fission products in the atmosphere, and (9) mean stratospheric residence time and fission products in the atmosphere. E.C.

N71-22450# Columbia Univ., New York. Columbia Astrophysics Lab.

STUDY OF THE DIFFUSE X-RAY BACKGROUND RADIATION IN THE SPECTRAL RANGE FROM 44 TO 100A AND THE DETERMINATION OF THE POLARIZATION OF

THE X-RAY EMISSION FROM THE CRAB NEBULA Final Report, 1 Mar. 1969 – 28 Feb. 1970
Robert Novick Nov. 1970 53 p refs
(Contract N00014-67-A-0108-0017)
(AD-717671) Avail: NTIS CSCL 3/2

A system for the detection of ultra-soft X rays (0.100 0.300 keV) employing grazing-incidence optics and thin window gas-flow proportional counters has been developed. This system is especially suited to photometric measurements of low-energy cosmic X-ray intensities. A rocket-borne X-ray polarimeter was flown to search for polarization in Taurus X-1. Although a result consistent with zero polarization was obtained, the statistics were such that X-ray polarization comparable in magnitude and direction to that of radio and optical continuum emission cannot be excluded. Author (GRA)

N71-22468# Lockheed Missiles and Space Co., Palo Alto, Calif.
ELECTRON DUMPING AT LOW ALTITUDES
S. N. Kuznetsov et al 1970 6 p refs Transl. into ENGLISH from Vestn. Musk. Univ., Fiz., Astron. (Moscow), no. 6, 1970 p 647 – 652
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

Results of investigations of trapped particles with energies greater than 60 and greater than 300 kev at 200 to 260 km altitudes using the earth satellite Cosmos-228 inclined 51 deg to the plane of the equator are presented. Great flows of quasi-trapped and dumped particles are measured at night in the Southern Hemisphere, and by day in the Northern Hemisphere. On the basis of the results obtained, longitude and altitude histories of the particles in the range $1.1 < \text{or} = L < \text{or} = 3.5$ are constructed. An estimate is given of the angular dependence of particles with E about 60 kev energy for L = 1.1, 1.3, 1.8, and 3.5. The process of particle dumping at night is analyzed. Author

N71-22498*# Iowa Univ., Iowa City. Dept. of Physics and Astronomy.
CHANGES IN THE DISTRIBUTION OF LOW ENERGY TRAPPED PROTONS ASSOCIATED WITH THE 17 APR. 1965, MAGNETIC STORM
A. L. Burns and S. M. Krimigis Mar. 1971 55 p refs
(Grant NGL-16-001-002; Contract N00014-68-A-0196-0003)
(NASA-CR-117839; Rept-71-8) Avail: NTIS CSCL 03B

The absolute intensity of geomagnetically trapped protons in the energy ranges $0.52 < \text{or} = E \text{ sub } p < \text{or} = 4.0$ MeV and $0.90 < \text{or} = E \text{ sub } p < \text{or} = 1.8$ MeV was measured with the solid state proton detector on the University of Iowa low altitude (initial apogee 2502 km, perigee 527 km), high latitude (inclination 81 deg) satellite Injun 4 for the period March 1 to May 31, 1965. A study of the temporal variations of these fluxes associated with the April 17, 1965, magnetic storm (sc 1313 UT April 17, main phase onset approximately 0200 UT April 18) shows a general redistribution of these protons for $L > 2.5$ and all sampled local geomagentic field vector ranges, which persisted for at least 36 days after the storm. The effect of the sudden commencement was a general depression in the intensities and a hardening of the energy spectrums, although the intensities recovered to their prestorm level during the initial phase. The major redistribution was apparently initiated by the polar substorm which began at approximately 0620 UT on April 18, and continued long after (to 1100 UT) the substorm had subsided (approximately 0800 UT). Author

N71-22502# Scientific Group for Space Research, Athens (Greece).
DATA OF SOLAR TERRESTRIAL INTEREST, DECEMBER 1970
D. J. Ilias and D. P. Elias, eds. Dec. 1970 15 p
Avail: NTIS

Routine observations of solar-terrestrial interest collected at three ionospheric and optical tracking stations in Athens (Greece) are presented. Tables include short wave fadeouts, ionospheric absorption measurements, and sunspot observations. No data are reported from satellite observations. E.M.C.

N71-22519# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science.
LABORATORY EXPERIMENT ON THE SOLAR WIND INTERACTION WITH PLANETARY BODIES
Haruya Kubo, Tomizo Itoh, and Akira Yamori Dec. 1970 10 p refs
(ISAS-458) Avail: NTIS

The electric field generated by the simulated interaction of the solar wind with planetary bodies is discussed. It is inferred from this experiment that an upper limit of the electric field behind the Moon would be on the order of 0.1V/m, and almost zero behind Venus. The mechanisms generating the electric and the magnetic field by the solar wind interaction are also discussed, and they would respectively be due to charge separation and pressure gradient drift. Author

N71-22578 Purdue Univ., Lafayette, Ind.
A STUDY OF THE ORIGIN AND PROPAGATION OF GALACTIC COSMIC RAY ELECTRONS
Gordon Bruce Berkey 1969 118 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 70-8857

The effects of spatial propagation, energy loss, boundary conditions, and the spatial distribution and energy spectrum of the electrons injected into interstellar space by the sources are all taken into account. Two models for spatial propagation are considered: isotropic diffusion and convection-diffusion, in which particle motion parallel to the disk plane is characterized by diffusion, while the particles are transported perpendicular to the disk by convection, caused by the outward expansion of the field lines. Parameters in both models are chosen to be consistent with the amount of material traversed by cosmic ray nuclei, the near isotropy of the cosmic-ray velocity distribution, and the existence of a galactic radio halo. In conclusion, it is pointed out that precise measurements of the positron spectrum and the background galactic gamma radiation are crucial to the selection of a model. Dissert. Abstr.

N71-22815# Israel Program for Scientific Translations, Ltd., Jerusalem.
ON THE PROBLEM OF THE AURORAL ABSORPTION ZONE SHIFTING DURING THE SOLAR ACTIVITY CYCLE
G. N. Gorbushina et al *In its* Probl. of the Arctic and the Antarctic 1970 p 115 – 121 refs (See N71-22801 11-13)
Copyright. Avail: NTIS HC $6.00/MF $0.95

Graphs have been constructed of latitudinal distribution of frequency of occurrence of auroral absorption at noon and midnight local time for the winter and summer of 1958 and 1962-63. The initial data for the evaluation of auroral absorption and determination of the position of the zone were ionospheric observations of minimum reflection frequencies at the network of high latitudinal stations in the Northern Hemisphere. Similar distributions were constructed for summer and winter at midnight for low magnetic activity and at noon for high magnetic activity. The graphs show that the absorption zone's position remained unchanged for the same level of magnetic activity at identical hours. The data demonstrate the lack of any direct correlation between the level of magnetic activity in the cycle and occurrence frequency of auroral absorption. More frequent and stronger ionospheric disturbances may be expected in years of low solar activity, for equal levels of magnetic activity, or the same solar wind parameters. A.L.

N71-22830# Israel Program for Scientific Translations, Ltd., Jerusalem.
THE RELATIONSHIP BETWEEN SOLAR ACTIVITY AND THE TEMPERATURE REGIME OF THE NORTHERN HEMISPHERE
A. I. Ol *In its* Prob. of the Arctic and the Antarctic 1970 p 251–253 refs (See N71-22801 11-13)
Copyright. Avail: NTIS HC $6.00/MF $0.95

The technique used to refute the conclusions reached by other investigators as to the relationship between solar activity and the temperature regime of the Northern Hemisphere is described. A.L.

N71-22900# Universidad Nacional de Colombia, Bogota.
OBSERVATORIO ASTRONOMICO NACIONAL THE BROWNIAN MOTION OF INTERSTELLAR GRAINS
Vladimir Garrido 1970 11 p refs *Its* Publ. del Observatorio Astronomico Nacl. No. 3
Avail: NTIS

The Brownian motion of interstellar grains is examined and the mean quadratic displacement is calculated in the following cases: (1) An axis associated with the grain describes a rotary Brownian motion under the effect of a torque originated by a constant, uniform external magnetic field, a torque due to the resistance force, and an aleatory torque produced by the disorder collisions of the grains with the molecules of the surrounding medium. (2) The grains undergo rotary Brownian motion under the action of the aleatory and small torques caused by paramagnetic absorption. (3) The grains are animated by a translational Brownian motion acting upon them from the aleatory and resistance force due to the surrounding medium. Author

N71-22966 Denver Univ., Colo.
ELECTRON ACCELERATION ASSOCIATED WITH STRONG HYDROMAGNETIC WAVES COLLISIONLESS PLASMA
John Allan Hasdal (Ph.D. thesis) 1969 105 p ref
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 70-7530

The measurement of low energy (1-3 ev) thermal electrons and 100-2000 ev electrons in the magnetosphere imply that acceleration mechanisms are operating. The plasma and magnetic field of the solar wind and the magnetosphere are shown to be described by macroscopic moment (fluid) equations. From these equations a stationary solution describing a solitary wave were derived. It was found that the fields of this wave act irreversibly upon electrons of initially greater than thermal energies; an acceleration. The accelerations produce a peak in an energy distribution, which is interpreted as a means to increase the average energy of the distribution. This can be related to the existence of a thermal plasma (1-3 ev) in the magnetosphere. Energies to 2 kev are also available from the effects of the wave motion, and are related to the electrons (100-2000 ev) found in the plasma sheet of the magnetosphere. An initial value problem related to the stationary wave solution shows that the magnetopause is a likely region for the generation of these waves. Dissert. Abstr.

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N71-21905# Boeing Scientific Research Labs., Seattle, Wash. Mathematical and Information Sciences Lab.
ANALYTICAL LUNAR EPHEMERIS: THE MEAN MOTIONS
Andre Deprit, Jacques Henrard, and Arnold Rom Aug. 1970 35 p refs
(AD-717282; DI-82-0990) Avail: NTIS CSCL 3/1

The Main Problem of Lunear Theory has been solved in a completely literal form; at places the development reaches terms of order 21 in the secularized Hamiltonian. In order to assess the accuracy reached in this manner, the constants are given the numerical values they have in the Improved Lunar Ephemeris and the series for the mean motions of node and perigee are evaluated. There is agreement on the principal parts within 1 second per Julian century with Brown's values as modified by Eckert. Author (GRA)

N71-21928# Colorado Univ., Boulder. Dept. of Astro-Geophysics.
PHYSICS ON THE SOLAR CORONA Final Report
Donald E. Billings 31 Jan. 1971 37 p refs
(Contract N00014-67-C-0290)
(AD-717636) Avail: NTIS CSCL 3/2

The document discusses studies of extreme ultra-violet spectroheliograms, green-line structures of coronal active regions, flare productivity as indicated by magnetic neutral lines, and H alpha fibril structures in chromospheric active regions. The second part is a summary of the twenty year program of research in coronal physics of which this contract was one part. Author (GRA)

N71-21935 Colorado Univ., Boulder.
A PRELIMINARY STUDY OF THE STRUCTURE AND STABILITY OF MODEL ENVELOPES FOR LONG PERIOD VARIABLE STARS
George Edward Langer (Ph.D. Thesis) 1969 182 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 70-5866

Approximately 50 models for the envelopes of long period variable stars were constructed, using the best available estimates for the luminosities and effective temperatures of typical variables, for 0.7, 1.0, 1.5, and 2.0 solar mass stars. Two different values for the mixing length (alpha = 0.7 and 1.0) have been used and four different compositions were considered. Features of each model are tabulated and the effect of changing uncertain parameters such as the mixing length or the mass of the star can be examined by comparing one model with another. Dissert. Abstr.

N71-21951# Joint Publications Research Service, Washington, D.C.
SOVIET BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY AND SPACE, NO. 246
12 Feb. 1971 102 p Transl. into ENGLISH from Russian reports (JPRS-52385) Avail: NTIS

CONTENTS:
1. ASTRONOMY p 1–4 (See N71-21952 11-30)
2. METEOROLOGY p 5–23 (See N71-21953 11-20)
3. OCEANOGRAPHY p 24–30 (See N71-21954 11-13)
4. TERRESTRIAL GEOPHYSICS p 31–37 (See N71-21955 11-13)
5. UPPER ATMOSPHERE AND SPACE RESEARCH p 38–80 (See N71-21956 11-13)

N71-21952# Joint Publications Research Service, Washington, D.C.
ASTRONOMY
In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 246 12 Feb. 1971 p 1–4 (See N71-21951 11-30)
Avail: NTIS

News releases, and abstracts of scientific articles concerning astronomy are presented. Included are the abstracts of gravitational moment of Jupiter and Saturn, and long-range forecast of Zurich series of Wolf numbers. F.O.S.

N71-21975 Georgetown Univ., Washington, D.C.
INTERFEROMETRIC MEASUREMENTS OF SOLAR WAVELENGTHS
James Edward O'Brien (Ph.D. Thesis) 1969 212 p
Avail: Univ. Microfilms: HC $9.70/Microfilm $3.00 Order No. 70-5929

The wavelengths of 157 solar absorption lines in the region 4675 to 6265 A were determined by interferometric comparison to the standard wavelengths of Hg-198. Interferograms were obtained from a Fabry-Perot interferometer crossed with a high dispersion, Wadsworth type spectrograph. Each wavelength value was calculated from the measurements of 6 fringe diameters on from 3 to 19 plates. The standard deviation is 0.0034 A. Experiments with simultaneous exposures to sun and mercury lamp indicate that systematic error due to the intermittent exposure method is less than 0.0001 A. Sixty-eight of the measured solar wavelenbths are due to iron lines. Laboratory wavelengths from both sources were used to calculate differences between solar wavelengths predicted by relativistic gravitational theory and observed values. No correlation with excitation potential could be found. However, dependence upon equivalent widths is indicated. Dissert. Abstr.

N71-22039# Technische Hochschule Munchen (West Germany). Inst. fuer Astronomische und Physikalische Geodaesie.
THEORY OF SATELLITE ORBITS, PART 1 [THEORIE DER SATELLITENBAHNEN, TEIL 1]
M. Schneider Bad Godesberg, West Ger. Bundesmin. fuer Bildung und Wiss. Dec. 1970 102 p In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Bildung und Wiss.
(BMBW-FB-W-70-68-Pt-1) Avail: NTIS; ZLDI Munich: 21 DM

Several kinds of equation of motion of a satellite are given. To illustrate them Kepler's problem is solved in some detail. Author (ESRO)

N71-22040# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
A PROGRAM FOR THE PREDICTION AND IMPROVEMENT OF ARTIFICIAL SATELLITE ORBITS [EIN PROGRAMM ZUR VORAUSBERECHNUNG UND VERBESSERUNG DER BAHNEN VON KUENSTLICHEN ERDSATELLITEN]
S. Heitz Bad Godesberg, West Ger. Bundesmin. fuer Bildung und Wiss. Nov. 1970 34 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Bildung und Wiss.
(BMBW-FB-W-70-64) Avail: NTIS; ZLDI Munich: 6,75 DM

The computer program was worked out especially for predictions for the observation of directions and distances to satellites using lasers. Author (ESRO)

N71-22046*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
OGO PROGRAM BIBLIOGRAPHY, SUPPLEMENT NO. 3
David T. Kohnhorst, comp. Jan. 1971 85 p refs
(NASA-CR-117758; NSSDC-70-01-Suppl-3) Avail: NTIS CSCL 22A

Abstracts of scientific and technical papers of the OGO program are presented for OGO-1 to OGO-5. Descriptions of OGO-6 experiments are included. F.O.S.

N71-22049# Joint Publications Research Service, Washington, D.C.
SOVIET BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 247
1 Mar. 1971 66 p Transl. into ENGLISH from Russian reports (JPRS-52498) Avail: NTIS

CONTENTS:

1. ASTRONOMY p 1-8 (See N71-22050 11-30)
2. METEOROLOGY p 9-15 (See N71-22051 11-20)
3. OCEANOGRAPHY p 16-30 (See N71-22052 11-13)
4. TERRESTRIAL GEOPHYSICS p 31-40 (See N71-22053 11-13)
5. UPPER ATMOSPHERE AND SPACE RESEARCH p 41-59 (See N71-22054 11-13)

N71-22050# Joint Publications Research Service, Washington, D.C.
ASTRONOMY
In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 247 1 Mar. 1971 p 1-8 (See N71-22049 11-30)
Avail: NTIS

A television system applied to observational astronomy for identification of faint objects is discussed, including the combined use of a television camera and a spectrograph for slit imaging during spectroscopic observations. A schematic plan of the initial stages preceding construction of a 6m telescope is given. A portable station for radiation balance measurements is proposed to aid in meteorological studies on the lunar surface. Completion of a two channel television telescope at the Pulkovo Observatory is announced; the specifications of this telescope are briefly given. Abstracts on various astronomical literature are presented, including lunar gravity anomalies, model of the Venusian atmosphere, and model of radio emission of Uranus. J.A.M.

N71-22099# Max-Planck-Institut fur Physik und Astrophysik, Munich (West Germany). Inst. fuer Extraterrestrische Physik.
EXPERIMENTS EI 88 AND EI 93 FOR MEASURING ENERGETIC ELECTRONS, PROTONS, AND ALPHA PARTICLES ONBOARD THE AZUR SATELLITE. PHYSICAL PROPERTIES AND TESTS MEASUREMENTS [DIE EXPERIMENTE EI 88 UND EI 93 ZUR MESSUNG VON ENERGIEREICHEN ELEKTRONEN, PROTONEN UND ALPHATEILCHEN IM SATELLITEN AZUR. PHYSIKALISCHE EIGENSCHAFTEN UND TESTMESSUNGEN]
Eberhard Achtermann, Bernd Haeusler, Dietrich Hovestadt, Erich Kuenneth, Peter Laeverenz et al Bad Godesberg, West Ger. Bundesmin. fuer Bildung und Wiss. Dec. 1970 54 p In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Bildung und Wiss.
(BMBW-FB-W-70-67) Avail: NTIS; ZLDI Munich: 11 DM

The satellite experiments were developed to measure the fluxes of protons from 1 to 100 MeV, alpha particles from 6 to 19 MeV, and electrons greater than 1.5 MeV within the radiation zone. The sensors were tested and calibrated in particle accelerators in respect to the aperture, the detecting sensitivity, and the efficiency to separate the different particles. The results are given and discussed. Author (ESRO)

N71-22109 California Univ., Berkeley.
ON SELF EXCITED VIBRATIONS IN PULSATING STARS
Timothy James Rudd (Ph.D. Thesis) 1969 85 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 70-6207

Pulsating stars exhibit periodic fluctuations in their brightness and radii. A simple model for one of these stars is considered. Self excited oscillations are shown to occur. The steady state radial vibrations are investigated and seen to have the same asymmetries as the observed pulsations. A brief discussion of the pulsating star phenomenon is included. The general governing equations for the star are used, together with certain simplifying assumptions, to deduce a nonlinear one-ozone model. This is analyzed for self excited oscillations and a unique limit cycle of the discontinuous type is found to occur. It has the correct asymmetries in the phase plane thereby extending Krogdahl's earlier work based on a self excited system of the Van Der Pol type. Dissert. Abstr.

N71-22110 California Univ., Berkeley.
EVOLUTION OF METAL RICH STARS
Silvia Torres-Castilleja (Ph.D. Thesis) 1969 132 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 70-6244

Evolutionary sequences for stellar configurations with chemical abundances varying from Z = 0.023 to 0.10 and from X = 0.60 to 0.68 were computed using the Berkeley Stellar Evolution program. The effect of the high metal abundance on the structure and evolution of the models was studied. It was found that, for the compositions under consideration, the presence of a hydrogen-burning convective core is directly determined by the luminosit of the models is the main sequence. No core was present for an age zero main sequence model fainter than M sub bol = 4.6. Isochrones were obtained from the models and were compared with the observed H-R diagrams of M 67, NGC 188, and NGC 6791 which have metal abundances 2 to 6 times higher than the solar metal abundance. Dissert. Abstr.

N71-22123# Houston Univ., Tex. Dept. of Mechanical Engineering.
ON THE DETERMINATION OF NEAR-BODY ORBITS USING MASS CONCENTRATION MODELS
James Lewis Raney and Bart Childs Dec. 1970 55 p refs
(Contract N00014-68-A-0151)
(AD-717330; RE-10-70) Avail: NTIS CSCL 22/3

The observations of a near-body satellite are used in the determination of certain constants appearing in a mathematical representation of the gravitational field of the central body. This representation is based on the assumption that the mass of the central body can be closely modeled by several concentrated masses located near its geometric center. The determination method employs a perturbation technique, numerical integration of linear and nonlinear differential equations, least-squares fitting criteria, and matrix inversion to determine estimates for the parameters involved. Several models for the representation of central body gravitational fields are discussed and the numerical techniques for evaluation of the parameters involved are briefly reviewed. The computations performed indicate that the parameters of such models can be estimated numerically. Some of the problems associated with using the method described herein to solve typical trajectory problems are discussed and some actual results are presented. Finally, suggestions for additional study of the theory and its applications are proposed. Author (GRA)

N71-22127# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE MECHANICS OF SPACEFLIGHT: SELECTED ARTICLES [MEKANIKA KOSMECHESKOGO POLETA]
I. S. Kozlov et al 16 Nov. 1970 34 p refs Transl. into ENGLISH from the Russian
(AD-717829; FTD-HT-23-554-70) Avail: NTIS CSCL 22/1

Contents: The problem of the minimum quantity of correction pulses in distant space travel; One case of stability of permanent rotations of a heavy solid with a liquid filling; Controlled non-nutational movement of a space vehicle around a center of mass. GRA

N71-22393*# National Aeronautics and Space Administration, Washington, D.C.
FROM APOLLO 11 TO THE SPACE STATIONS OF THE FUTURE
H. Cohen *In* Natl. Council for Civil Aviation Civil Aviation in the 1970's 1969 29 p (See N71-22381 11-30)
(NASA-TM-X-67072) Avail: NTIS CSCL 22A

The rationale behind the development and deployment of space stations is presented. The next natural step to take in space will be to create permanent space stations in earth and lunar orbits with low cost access by reusable chemical and nuclear rocket transportation systems, and to utilize these systems in assembling a capability to explore the planet Mars with men. Author

N71-22394*# National Aeronautics and Space Administration, Washington, D.C.
CONTRIBUTIONS OF THE SPACE PROGRAMME TO AVIATION
H. Cohen *In* Natl. Council for Civil Aviation Civil Aviation in the 1970's 1969 25 p (See N71-22381 11-30)
(NASA-TM-X-67073) Avail: NTIS CSCL 22A

Contributions to air transport safety resulting from developments conducted by space programs are discussed. Subjects presented are: (1) meteorological and navigation satellites, (2) communications satellites, (3) flight recorders, (4) structural analysis, (5) inertial guidance systems, (6) systems for monitoring physical condition of flying personnel, and (7) manufacturing processes under conditions of weightlessness and vacuum to produce new materials. Author

N71-22411*# Israel Program for Scientific Translations, Ltd., Jerusalem.
PROCEEDINGS OF THE SIXTH WINTER SCHOOL ON SPACE PHYSICS, PART 1
S. N. Vernov, ed., et al 1971 333 p refs Transl. into ENGLISH from the publ. 'Trudy Shestoi Vsesoyuznoi Ezhegodnoi Zimnei Shkoly Po Kosmofizike' Moscow, Akad. Nauk SSSR, 1969 Conf. held at Apatity, 18 Mar.–1 Apr. 1969 Supported by NASA and NSF
(NASA-TT-F-629; TT-70-50079) Copyright. Avail: NTIS HC $6.00/MF $0.95 CSCL 22A

CONTENTS:

1. THE UNIVERSE, GALAXIES AND STARS p 11–108 refs (See N71-22412 11-30)
2. X-RAYS, GAMMA RAYS, ELECTRONS AND NEUTRINO p 109–197 refs (See N71-22413 11-29)
3. PHYSICS OF THE SOLAR ACTIVITY AND DYNAMIC PROCESSES IN THE INTERPLANETARY SPACE AND IN THE EARTH'S MAGNETOSPHERE p 199–332 refs (See N71-22414 11-29)

N71-22412*# Israel Program for Scientific Translations, Ltd., Jerusalem.
THE UNIVERSE, GALAXIES AND STARS
G. E. Kocharov, ed., et al *In its* Proc. of the Sixth Winter School on Space Phys., Part 1 1971 p 11–108 refs (See N71-22411 11-30)
Copyright. Avail: NTIS HC $6.00/MF $0.95 CSCL 03C

Research papers on theoretical models and spectral measurements are presented. Cosmological models, charge symmetry of the universe, and verification of the gravitation theory in cosmology are discussed. Galactic evolution, expansion, and separation into halo and disk subsystems, and stellar evolution and gas ejection are described. Extragalactic background radiation and antiproton fluxes in primary cosmic rays are studied. Cosmos 135 gamma ray measurements were taken to investigate antimatter in meteor streams. N.E.N.

N71-22415*# Israel Program for Scientific Translations, Ltd., Jerusalem.
PROCEEDINGS OF THE SIXTH WINTER SCHOOL ON SPACE PHYSICS, PART 2
S. N. Vernov, ed., et al 1971 195 p refs Transl. into ENGLISH of the publ. 'Trudy Shestoi Vsesoyuznoi Ezhegodnoi Zimnei Shkoly Po Kosmofizike' Moscow, Akad. Nauk SSSR, [1969] Conf. held at Apatity USSR, 18 Mar.–1 Apr. 1969 Supported by NASA and NSF

(NASA-TT-F-630; TT-70-50080) Copyright Avail: NTIS CSCL 03B

CONTENTS:

1. COMETS, METEORITES AND THE MOON V. A. Dergachev et al p 3-30 refs (See N71-22416 11-30)

2. GENERATION, ENERGY SPECTRUM, VARIATIONS AND PROPAGATION OF COSMIC RAYS S. N. Vernov et al p 33-93 refs (See N71-22417 11-29)

3. METHODOLOGICAL PROBLEMS V. A. Dergachev et al p 97-192 refs (See N71-22418 11-30)

N71-22416*# Israel Program for Scientific Translation, Ltd., Jerusalem.

COMETS, METEORITES AND THE MOON

V. A. Dergachev, ed., et al *In its* Proc. of the Sixth Winter School on Space Phys., Part 2 1971 p 3-30 refs (See N71-22415 11-30)

Copyright. Avail: NTIS CSCL 03B

Direct and laboratory studies of comets are summarized. Characteristics of comets, absolute photometry of comet nuclei, and dynamic processes in comets are described, and specific studies of Comet Honda 1968c and the brightness of Comet Ikeya-Seki 1970n are mentioned. Lunar morphology and the chemical composition of the lunar surface, and geophysical effects of the 1908 Tunguska meteorite blast are also considered. N.E.N.

N71-22418*# Israel Program for Scientific Translations, Ltd., Jerusalem.

METHODOLOGICAL PROBLEMS

V. A. Dergachev, ed., et al *In its* Proc. of the Sixth Winter School on Space Phys., Part 2 1971 p 97-192 refs (See N71-22415 11-30)

Copyright. Avail: NTIS CSCL 12A

Data processing and instrument development for investigations of space radiation phenomena are reported. Statistical analyses, correction for instrument error, coincidence effects, and computer processing are discussed. Instrumentation is described for X-ray bremsstrahlung measurement, cosmic ray intensity measurement, spark and bubble chambers, optical systems of Cherenkov and scintillation counters, five-channel signal analyzer, fast neutron scintillation detector, and multichannel gamma spectrometer. N.E.N.

N71-22474*# IIT Research Inst., Chicago, Ill. Astro Sciences.

LONG RANGE PLANNING FOR SOLAR SYSTEMS EXPLORATION Annual Summary Report, 1 Nov. 1968-31 Dec. 1969

Feb. 1970 67 p refs

(Contract NASw-1837)

(NASA-CR-117845; A-7; ASR-6) Avail: NTIS CSCL 03B

Advanced mission studies are summarized, providing a preliminary understanding of candidate missions and mission requirements for long range exploration of the solar system. The outer planets and comet rendezvous investigations are emphasized, including soft landing missions to the Galilean satellites of Jupiter and Mars orbital characteristics. Jupiter gravity-assisted trajectories, guidance analysis of the multiple outer planet mission, comet missions, and horizons in space are briefly outlined. Computer codes, MOLIMP, SURVEY, and ORBOBS, were also written. J.A.M.

N71-22515# Toronto Univ. (Ontario). Inst. for Aerospace Studies.

INSTITUTE FOR AEROSPACE STUDIES Annual Progress Report, 1970

Nov. 1970 225 p refs

Avail: NTIS

Research is summarized on the following topics: mechanics of rarefied gases; plasma dynamics; combustion, explosions, hypervelocity, and two-phase flows; MHD power generation and earth resource satellites; aerodynamic noise; subsonic aerodynamics; space dynamics; materials science and structures; rocket research; space simulation and surface interactions; high temperature gas dynamics and gas physics; laser excitation diagnostics and environmental sensing; flight and air cushion transportation; atmospheric trace gas studies; sonic boom; and industrial and architectural aerodynamics. N.E.N.

N71-22528*# Oak Ridge National Lab., Tenn. Health Physics Div.

RESEARCH ON STIMULATED EXOELECTRON EMISSION FROM LUNAR MATERIALS Technical Progress Report

R. B. Gammage and Klaus Becker Oct. 1970 33 p refs

(NASA Order T-90269; Contract W-7405-eng-26)

(NASA-CR-117853; ORNL-TM-3131) Avail: NTIS CSCL 03C

Preliminary results on the thermally stimulated exoelectron emission (TSEE) from Apollo 12 fines and rocks show little emission from virgin materials, but intense TSEE at various temperatures between 130 and 550 C can be induced by: (1) oxidation of the surface, (2) adsorption of O2, and perhaps (3) the release of trapped solar wind. The TSEE characteristics of differently treated samples are a sensitive indicator of changes occurring on the surface and have, therefore, been studied in some detail. Author (NSA)

N71-22529*# Chicago Univ., Ill. Enrico Fermi Inst.

METEORITES AND THE EARLY SOLAR SYSTEM

Edward Anders Dec. 1970 71 p refs Submitted for publication Supported in part by Komm. fuer Weltraumforsch. der Schweiz. Naturforschenden Ges.

(Grant NGR-14-001-010; Contract AT(11-1)-382)

(NASA-CR-117755; EFI-70-71; COO-3882-107) Avail: NTIS CSCL 03C

An overview is presented on the origin of meteorites and their relation to the early solar system. Particular emphasis is placed on an existing view that chondrites are an original and relatively unaltered condensate from the solar nebula. On this basis, classifications of chondrites are given along with compositions of primordial matter. The major portion of the presentation is devoted to a review of the processes that may have influenced the chemistry and mineralogy of chondrites. In addition, a discussion is given of the time scale of meteorite evolution. A summation of the principal conclusions is included together with a review of the implications for planetary cosmogony. D.L.G.

N71-22537* National Aeronautics and Space Administration. Washington, D.C.

ISIS-B: PRESS KIT

25 Mar. 1971 16 p

(NASA-News-Release-71-41) Avail: NASA Scientific and Technical Information Facility, P.O. Box 33, College Park, Md. 20740 CSCL 22A

Prelaunch background information for the ISIS-B (International Satellite for Ionospheric Studies) is reported. Primary scientific objectives of ISIS-B are to continue the program of measuring daily and seasonal fluctuations in the electron density of the upper ionosphere, study radio and cosmic noise emissions, and conduct correlative direct measurements of the energetic particles interacting with the ionosphere. E.M.C.

N71-22539*# Bellcom, Inc., Washington, D.C.

EFFECTS OF PHYSICAL LIBRATIONS OF THE MOON ON THE ORBITAL ELEMENTS OF A LUNAR SATELLITE

A. J. Ferrari and W. G. Heffron 29 Mar. 1971 22 p refs

(Contract NASw-417)

(NASA-CR-117841; TM-71-2014-3) Avail: NTIS CSCL 03C

If the orbital elements of a lunar satellite are referred to

selenographic axes in the true moon as it rotates and librates, then the librations cause changes in the orientation angles (node, inclination and periapsis argument) large enough that long period planetary perturbation theory cannot be used without compensation for such geometrical effects. As a second effect, the gravitational potential of the moon is actually wobbled in inertial space, a condition not included in the potential expression used in planetary perturbation theory. Data are given on the magnitude of the physical librations, the geometrical effects on the orbital elements and the equivalent changes in the coefficients in the potential. Author

N71-22551*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
JPL QUARTERLY TECHNICAL REVIEW, VOLUME 1, NO. 1
Apr. 1971 317 p refs
(Contract NAS7-100)
(NASA-CR-117850) Copyright. Avail: NTIS HC $6.00/MF $0.95 CSCL 22A

CONTENTS:

1. SATELLITE FLYBY OPPORTUNITIES FOR THE MULTI OUTER PLANET MISSIONS P. A. Penzo p 1-12 refs (See N71-22552 11-30)

2. APPLICATIONS OF FORMAC IN THE MATHEMATICS OF GENERAL RELATIVITY H. D. Wahlquist p 13-16 refs (See N71-22553 11-19)

3. A HIGHER PERFORMANCE ELECTRIC ARC DRIVEN SHOCK TUBE W. A. Menard p 17-28 refs (See N71-22554 11-11)

4. SOLID PROPELLANT BURNING RATE MODIFICATION M. F. Humphrey p 29-34 (See N71-22555 11-27)

5. LOW ACCELERATION RATE IGNITION FOR SPACECRAFT J. I. Shafer, L. D. Strand, and F. A. Robertson p 35-44 refs (See N71-22556 11-27)

6. CYANATE ION AND THE UREMIC SYNDROME J. D. Ingham p 45-48 refs (See N71-22557 11-04)

7. OIL ABSORBING POLYMERS H. E. Marsh, Jr. p 49-56 refs (See N71-22558 11-06)

8. FATIGUE OF TEFLON BLADDER BAG MATERIALS E. F. Cuddihy p 57-63 refs (See N71-22559 11-18)

9. LIQUID METAL MHD POWER CONVERSION D. J. Cerini p 64-67 ref (See N71-22560 11-25)

10. DESIGN AND DEVELOPMENT OF A 66-W/kg 23-m SQUARE ROLL UP SOLAR ARRAY W. A. Hasbach p 68-77 ref (See N71-22561 11-03)

11. LARGE SPACECRAFT ANTENNAS: NEW GEOMETRIC CONFIGURATION DESIGN CONDEPTS R. E. Oliver p 78-85 ref (See N71-22562 11-07)

12. ANTENNA SUPPORT STRUCTURE APERTURE BLOCKAGE LOSS A. Ludwig p 86-96 refs (See N71-22563 11-07)

13. INTERPLEX MODULATION S. Butman and U. Timor p 97-105 refs (See N71-22564 11-07)

14. CALCULATION OF SPACE CHARGE FORCES IN THE ANALYSIS OF TRAVELING WAVE TUBES H. K. Detweiler p 106-115 refs (See N71-22565 11-09)

15. A MAGNETIC TAPE RECORDER FOR LONG OPERATING LIFE IN SPACE E. Bahm p 116-124 refs (See N71-22566 11-08)

16. LUNAR TRAVERSE MISSIONS R. G. Brereton, J. D. Burke, R. B. Coryell, and L. D. Jaffe p 125-137 refs (See N71-22567 11-30)

N71-22552*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Mission Analysis Div.
SATELLITE FLYBY OPPORTUNITIES FOR THE MULTI OUTER PLANET MISSIONS
P. A. Penzo *In its* JPL Quarterly Tech. Rev., Vol. 1, No. 1 Apr. 1971 p 1-12 refs (See N71-22551 11-30)
Copyright. Avail: NTIS HC $6.00/MF $0.95 CSCL 22A

Satellite encounter opportunities are generated for two multiple flyby missions which include all five of the major planets. Many favorable encounter opportunities have been found for the large satellites of Jupiter, and some for Titan and Iapetus of Saturn. The opportunities for satellites of Uranus are least favorable. Opportunities also exist for multiple satellite encounters on the same mission and examples are shown. Finally, for Jupiter, some arrival dates exist where very close flybys of certain satellites are possible. These opportunities, added to the multiple planet missions, will enhance their scientific return significantly. Author

N71-22567*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LUNAR TRAVERSE MISSIONS
R. G. Brereton, J. D. Burke, R. B. Coryell, and L. D. Jaffe *In its* JPL Quarterly Tech. Rev., Vol. 1, No. 1 Apr. 1971 p 125-137 refs (See N71-22551 11-30)
Copyright. Avail: NTIS HC $6.00/MF $0.95 CSCL 22A

The results of recent studies on Lunar traverse missions are compared with the announced characteristics of the Soviet Lunokhod 1 rover, delivered to the Moon by the Luna 17 spacecraft in November 1970. Except for some differences in emphasis among the scientific experiments, the Lunokhod mission is quite similar to those recommended in the USA studies. Author

N71-22621*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ERROR ANALYSIS OF THE MARS GRAVITATIONAL FIELD ESTIMATION USING RANGE AND RANGE-RATE DATA FROM A VIKING-TYPE ORBITER
Harold R. Compton and Edward F. Daniels Washington Apr. 1971 45 p refs
(NASA-TN-D-6219; L-7502) Avail: NTIS CSCL 03C

Standard deviations associated with a weighted least-squares process for estimating the spherical harmonic coefficients in the Mars gravitational potential function are presented for the coefficients through degree and order four. These standard deviations were calculated by using a priori uncertainties on the assumed estimated coefficients and model error uncertainties in the tracking-station location, the Mars ephemeris, the astronomical unit, the Mars gravitational constant, and the gravitational coefficients form degree five and order zero through degree and order seven. The tracking data types were assumed to be earth-based range and range-rate measurements from an artificial satellite about Mars. A comparison of the results for the use of each data type independently and in combination is presented. Author

N71-22682# Joint Publications Research Service, Washington, D.C.
SOVIET BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 248
16 Mar. 1971 81 p refs Transl. into ENGLISH from various Soviet bloc publications
(JPRS-52634) Avail: NTIS

CONTENTS:

1. ASTRONOMY p 1-3 (See N71-22682 11-30)

2. METEOROLOGY p 4-10 (See N71-22684 11-20)

3. OCEANOGRAPHY p 11-19 (See N71-22685 11-13)

4. TERRESTRIAL GEOPHYSICS p 20-25 refs (See N71-22686 11-13)

5. UPPER ATMOSPHERE AND SPACE RESEARCH p 26-57 refs (See N71-22687 11-20)

6. DETAILED DESCRIPTION OF "LUNOKHOD-1" p 59-74 (See N71-22688 11-31)

N71-22683# Joint Publications Research Service, Washington, D.C.
ASTRONOMY
In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 248 16 Mar. 1971 p 1-3 (See N71-22682 11-30)
Avail: NTIS

Abstracted data are presented on pulsar studies along with a news article on a photoelectric sensor for tracking both the sun and moon. Pulsar radio emission at 25 hertz and second-class oscillations were measured, and pulsar observations were used to determine the inhomogeneous structure of interstellar plasmas. N.E.N.

N71-22763 Washington Univ., Seattle.
THE GASEOUS COMPONENT OF THE PECULIAR GALAXY NGC 5253
Gary Alan Welch (Ph.D. Thesis) 1969 208 p
Avail: Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 70-8506

Results are reported of an extensive investigation, directed primarily at the emission component, of the peculiar galaxy NGC 5253. Along the major axis the overall surface brightness profile in continuum light resembles that of a relaxed system. There is no similarity to the brightness profiles of galaxies such as NGC 4449 and the LMC which are dominated by a young population. This fact and the lack of resolution of bright stars which would otherwise be expected leads to the suggestion that such a population is absent in NGC 5253, that the overall stellar content of the galaxy resembles that of an elliptical system. The electron temperature of the ionized gas is found to be 12,500 K in high excitation regions and approximately 400 K in areas of low excitation. The ratio N(He)/N(H) in the gas is found to be approximately 0.14, a value not significantly different than for objects in our galaxy. On the other hand nitrogen appears overabundant with respect to oxygen by a factor between 4 and 10 which can be explained by supposing that much of the gas has been ejected by evolving stars. If this suggestion is correct then stellar evolutionary mass loss in NGC 5253 has taken place on a scale much greater, relative to the total mass of the galaxy, than in any other known system. Dissert. Abstr.

N71-22766*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE DEEP SPACE NETWORK, VOLUME 1 Progress Report, Nov.-Dec. 1970
15 Feb. 1971 131 p refs
(Contract NAS7-100)
(NASA-CR-117849; JPL-TR-32-1526) Avail: NTIS CSCL 22C

This report series presents progress on the Deep Space Network (DSN) supporting research and technology, advanced development and engineering, and implementation, and DSN operations pertaining to mission-independent or multiple-mission developments and to support of flight projects. For individual titles, see N71-22767 through N71-22790.

N71-22768*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MARINER MARS 1971 MISSION SUPPORT
R. P. Laeser *In its* The Deep Space Network, Vol. 1 15 Feb. 1971 p 4-6 refs (See N71-22766 11-30)
Avail: NTIS CSCL 22C

The DSN support plans for the Mariner Mars 1971 mission were modified by moving the analog playback function from the media conversion center to the compatibility test area and by assuming the responsibility for sequence of event generation computer software. The cost reductions and plans are discussed in detail. Author

N71-22767*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DSN FUNCTIONS AND FACILITIES
N. A. Renzetti *In its* The Deep Space Network, Vol. 1 15 Feb. 1971 p 1-3 refs (See N71-22766 11-30)
Avail: NTIS CSCL 22C

The objectives, functions, and organization of the Deep Space Network are summarized. The Deep Space Instrumentation Facility, the Ground Communications Facility, and Space Flight Operations Facility are described, and their functions and operations cited. Author

N71-22768*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
VIKING MISSION SUPPORT
D. J. Mudgway *In its* The Deep Space Network, Vol. 1 15 Feb. 1971 p 7-10 ref (See N71-22766 11-30)
Avail: NTIS CSCL 22C

Trajectory design factors, launch/arrival times, look angle between spacecraft, communication range and signal level, solar conjunction, and near earth phase trajectories are discussed for the Viking project. Author

N71-22769*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
CHOICE OF INTEGRATORS FOR USE WITH A VARIATION OF PARAMETERS FORMULATION
T. D. Talbot and E. A. Rinderle *In its* The Deep Space Network, Vol. 1 15 Feb. 1971 p 117-121 refs (See N71-22766 11-30)
Avail: NTIS CSCL 22A

A comparison of three integrators is made in an effort to choose the one best suited for variations of parameters computations of the orbits of satellites. The numerical results and conclusions of the study are given. Author

N71-22987 California Univ., Los Angeles.
SECULAR PERTURBATIONS IN THE SOLAR SYSTEM
James Gerard Williams (Ph.D. Thesis) 1969 285 p
Avail: Univ. Microfilms: HC $12.85/Microfilm $3.70 Order No. 70-8224

One of the tools used to study the asteroid belt is proper elements; orbital elements which have the very long period secular perturbations by planets removed. The theory which was used to calculate these proper elements in the past uses a truncated series expansion which is suitable only for small eccentricities and inclinations. Gauss' method allows secular perturbations to be calculated for nearly any eccentricity or inclination but the various oscillating terms are not separated and proper elements cannot be calculated. The method proposed in the study uses classical perturbation theory to isolate each of the periodic terms in the differential equations of the elements that Gauss' method gives. Direct orbits of nearly any semimajor axis, eccentricity, and inclination can be treated so long as the orbit does not cross the orbit of a planet or have commensurable mean motions with a planet. The separated differential equations can be solved numerically and the resulting functions have useful symmetry and periodicity properties. Dissert. Abstr.

N71-23003 California Univ., Los Angeles.
THE DEVELOPMENT OF THE NOVA OUTBURST IN DQ HERCULIS
Sumner Grosby Starrfield (Ph.D. Thesis) 1969 173 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 70-8210

The hypothesis that the mechanism for the nova outburst is a thermal runaway in the envelope of a white dwarf has been confirmed for DQ Herculis. A computer program for the study of short time scale phenomena in stellar evolution has been developed to study the evolution of a white dwarf envelope. The envelope has a thin layer of hydrogen-rich material overlying a helium-rich core. The observations of DQ Herculis at minimum have been examined; they suggest that material is presently being accreted by the white

dwarf component. Because of the accretion of material, a shock-front is present and is responsible for the observed luminosity and effective temperature of the old nova. Dissert. Abstr

N71-23090*# Israel Program for Scientific Translations, Ltd., Jerusalem.
INTERPLANETARY FLIGHT AND COMMUNICATION VOLUME 1: NO. 1: DREAMS, LEGENDS, AND EARLY FANTASIES
N. A. Rynin 1970 117 p refs Transl. into ENGLISH of the publ. 'Mezhplanetynye Soobshcheniya: Mechty, Legendy i Pervye Fantazii' Leningrad, 1928 Supported by NASA and NSF
(NASA-TT-F-640; TT-70-5011) Copyright. Avail: NTIS CSCL 22A

An account is given of the writings of early poets and novelists dealing with the mythical and legendary concepts of interplanetary flight. D.L.G.

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N71-21881* Douglas Aircraft Co., Inc., Santa Monica, Calif.
ARTIFICIAL GRAVITY SPIN DEPLOYMENT SYSTEM Patent
Bradford P. Donovan and Kenneth G. Englar, inventors (to NASA) Issued 1 Aug. 1967 (Filed 22 Oct. 1965) 8 p Cl. 244-1 Sponsored by NASA
(NASA-Case-XNP-02595; US-Patent-3,333,788; US-Patent-Appl-SN-502709) Avail: US Patent Office CSCL 22B

A way of providing an artificial gravity environment in a manned space vehicle is described. It utilizes presently available boosters as the space vehicle. Generally, when in space, the vehicle is rotated like a pinwheel and then is separated into two sections connected by a cable arrangement. The wheel action provides an artificial gravity. The further apart the sections are, the slower they can rotate and the less discomfort to the crew. A spring-urged strut arrangement is used during early separation of the two sections to provide positive control and resist bending of one section relative to the other. Official Gazette of the U.S. Patent Office

N71-21990*# National Aeronautics and Space Administration, Washington D. C.
LABORATORY AND OBSERVATORY FACILITIES
Rodney W. Johnson 1970 50 p Presented at the NASA Briefing on Space Sta. Plans and Programs, Paris, 3–5 Jun. 1970; sponsored by ESRO
(NASA-TM-X-67053; MF70-6072 Avail: NTIS CSCL 22A

Two major areas are covered, payload planning and commonality analysis. In order to provide a basis for station design studies, the experiment and research program which the station should be capable of supporting, were planned. Once these candidate payloads were identified it was attempted to determine how they could be accommodated. Through contracted studies, it was proved that a "common" module approach offers substantial cost savings, flexibility in scheduling and flight, and an affordable space research program. Author (ESRO)

N71-22018# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DYNAMICS OF THREE DIMENSIONAL MOTION OF CONTROLLED ROCKETS [DINAMILKA PROSTRANSTVENNOGO DVIZHENIYA UPRAVLYAEMYKH RAKET]
V. K. Svyatodukh 9 Dec. 1970 324 p refs Transl. into ENGLISH from the Russian
(AD-717821; FTD-HC-23-258-70) Avail: NTIS CSCL 16/2

The book deals with the motion near the mass center of guided, rotating and roll-stabilized rockets, taking into account aerodynamic, instrumental and inertial cross connections. Author (GRA)

N71-22019# Lockheed Missiles and Space Co., Sunnyvale, Calif.
THERMODYNAMICS AND THERMOPHYSICS OF SPACE FLIGHT Final Report
Henry Cohan, D. L. Calvert, and H. M. Satterlee Jan. 1971 299 p refs Proc. of a Conf. Held at Palo Alto, Calif., 23–25 Mar. 1970
(Contract F44620-69-C-0120)
(AD-717822; AFOSR-TR-71-0079) Avail: NTIS CSCL 22/2

The newly developed engineering science of spacecraft temperature control continues to change at a rapid pace. As a means of assisting and encouraging the disemination of new developments a symposium was held at the Lockheed Research Labs. in 1970. The symposium was jointly sponsored by the Air Force Office of Scientific Research and the Lockheed Missiles and Space Co. The technical program of 17 papers in four broad catagories comprises the contents of this volume. Four general classes of papers are presented: New computational techniques with complex computer design and optimal control theory; point designs for a solar array, an antenna and an optics system; thermal control techniques for energy exchange with high flux rates, passive systems and coolant loop systems design; and materials development with special coatings and insulations for spacecraft surfaces. Author (GRA)

N71-22041*# National Aeronautics and Space Administration, Washington, D. C.
SPACE STATION PROGRAM PLANS
Douglas R. Lord 1970 41 p Presented at the NASA Briefing on Space Sta. Plans and Programs, Paris, 3–5 Jun. 1970; sponsored by ESRO
(NASA-TM-X-67051; MF70-6049) Avail: NTIS CSCL 22A

The evolution of space station concepts is reviewed. The contracts with industrial firms with emphasis placed on the phase B (program definition) studies are listed as well as different program studies on earth orbital experiment requirements, the experiment module concept, information management, crew operations, damage containment and control, and habitability and crew equipment. ESRO

N71-22042*# National Aeronautics and Space Administration, Washington, D. C.
A SPACE STATION OVERVIEW
Charles W. Mathews 1970 69 p Presented at the NASA briefing on Space Sta. Plans and Programs, Paris, 3–5 Jun. 1970; sponsored by ESRO
(NASA-TM-X-67052; ML70-5149) Avail: NTIS CSCL 22B

The capabilities developed in Apollo provide the basis for the next steps; the space stations, Skylab program which involves modest modifications to Apollo flights, is reviewed with regard to its objectives, earth survey operations, experiments, and crew quarters. The space station is described and its characteristics listed as well as its applications, technology, and engineering operations. Finally, long term projects such as space bases, planetary vehicles involving use of nuclear shuttles for Mars exploration, space transporters, and space shuttles and their missions are described. ESRO

N71-22100*# National Aeronautics and Space Administration, Washington, D. C.
ADVANCED TECHNOLOGY REQUIREMENTS

Douglas R. Lord 1970 69 p Presented at the NASA Briefing on Space Sta. Plans and Programs, Paris, 3–5 Jun. 1970; sponsored by ESRO
(NASA-TM-X-67049; MF70-6070) Avail: NTIS CSCL 22B

Advanced technology requirements for the space stations and the space bases are reviewed such as nuclear electric power generation, solar cell arrays, rechargeable earth satellite batteries, power conversion electronics, information management system, inertial guidance, space data storage, space station and space base simulated control, artificial gravity dynamics, space station structures and environmental protections, meteoroid design environment, integrated life support systems, etc. ESRO

N71-22126*# National Aeronautics and Space Administration, Washington, D. C.
TECHNOLOGY UTILIZATION
Rodney W. Johnson 1970 55 p Presented at the NASA Briefing on Space Sta. Plans and Programs, Paris, 3–5 Jun. 1970; sponsored by ESRO
(NASA-TM-X-67050; MF70-6095) Avail: NTIS CSCL 22B

Technology utilization embraces four areas of space station activities: advanced technology research, MSF engineering and operations, space processing and manufacturing, and aerospace medicine research. In all four areas, the space station will be used to accomplish development work leading to improvements in spacecraft systems and uses of expanded research capabilities which will become operational when the orbital complex expands its operations toward the size envisioned for the space base. Author (ESRO)

N71-22178*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
NATURAL ENVIRONMENT CRITERIA FOR THE NASA HIGH ENERGY ASTRONOMY OBSERVATORY (HEAO)
Don K. Weidner and George S. West, eds. 25 Mar. 1971 24 p refs
(NASA-TM-X-64576) Avail: NTIS CSCL 22B

Natural environment criteria are provided for the NASA HEAO Program with emphasis on the 1974 to 1978 time period. Information on atmospheric and ionospheric properties, radiation, solar cycle predictions, geomagnetic field, astrodynamic constants, and meteoroids is given for the region of space within 1000 km from the earth's surface. Author

N71-22181# Ludwig-Maximilians-Universitat, Munich (West Germany). Meteorologisches Inst.
EXPERIMENTS FOR METEOROLOGICAL SATELLITES OR A SPACE STATION [EXPERIMENTE FUER METEOROLOGISCHE SATELLITEN ODER EINE WELTRAUMSTATION]
Hans-Juergen Bolle comp. and Renate Beffert comp. Bad Godesberg, West Ger. Bundesmin. fuer Bildung und Wiss. Dec. 1970 256 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Bildung und Wiss.
(BMBW-FB-W-70-70) Avail: NTIS; ZLDI Munich: 53,55 DM

A number of experiment proposals for indirect soundings of the atmosphere from satellites or from a space station are discussed. Author (ESRO)

N71-22222# Max-Planck-Institut fur Aeronomie, Lindau uber Northeim (West Germany).
ADDITIONAL ROCKET PROGRAM FOR THE SATELLITE PROJECT AZUR, PROJECT SPAZ. PART 1: THE SCIENTIFIC PAYLOAD [DAS ZUSATZRAKETENPROGRAMM ZUM SATELLITENPROJEKT AZUR, PROJEKT SPAZ. TEIL 1: DIE WISSENSCHAFTLICHE NUTZLAST]
M. Schnell, H. Schuetz, W. Stuedemann, K. Wilhelm, D. Beran et al Bad Godesberg, West Ger. Bundesmin. fuer Bildung und Wiss. Nov. 1970 182 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Bildung und Wiss. Prepared jointly by DFVLR, Kiel Univ., Tech. Univ. Brunswick, and Arbeitsgruppe fuer Physik. Weltraumforsch.
(BMBW-FB-W-70-59) Avail: NTIS; ZLDI Munich: 34,30 DM

The Spaz rocket program, consisting of five rocket payloads is described, especially the instruments onboard these rockets. The program was set up in order to contribute additional measurements to those obtained with the satellite Azur. The rockets have been fired from Andoya (Norway) during auroral zone events. Author (ESRO)

N71-22223# Junkers Flugzeug- und Motorenwerke A. G., Munich (West Germany).
FEASIBILITY STUDY FOR A LIFTING REENTRY BODY, SHORT VERSION [DURCHFUEHRBARKEITSSTUDIE FUER EINEN AERODYNAMISCHEN WIEDEREINTRITTSKOERPER (KURZFASSUNG)]
E. Schaefer et al Bad Godesberg, West Ger. Bundesmin. fuer Bildung und Wiss. Dec. 1970 120 p In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Bildung und Wiss.
(BMBW-FB-W-70-66) Avail: NTIS; ZLDI Munich: 24,60 DM

Future space activity will be based to a large extent upon orbital stations which are to be supplied and maintained as regularly as usual in today's aircraft traffic. A program is given in this feasibility study which is financially comparable with a medium size satellite allowing for a reentry development and representing an extremely interesting task for research and space industry. Basic problems of aeroballistic space transport systems could be solved and, as an interim result, a recoverable satellite would be obtained. Technically and economically a real gap could be closed in today's and future space transport problems. Author (ESRO)

N71-22332# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DYNAMICS OF MISSILES
K. A. Abgaryan et al 6 Nov. 1970 503 p refs Transl. into ENGLISH of the book "Dinamika Raket" Moscow, Izd. Mashinostroyeniye, 1969 p 1–378
(AD-717820; FTD-MT-24-189-70) Avail: NTIS HC $6.00/MF $0.95 CSCL 16/4

In the book are discussed fundamentals of dynamics of rocket operating on solid and liquid propellants. There are listed equations of undisturbed and disturbed motion of rockets as bodies of variable composition, methods of linearization of equations and decomposition of linearized equations into separate groups. There are examined stability and controllability of the rocket, its transfer functions and dynamic characteristics as the object of control. There are comprehensively examined questions of stabilization of the rocket taking into account the elasticity of its construction and mobility of liquid propellant in the tanks. The book is intended for students of engineering colleges and can be useful for engineers of the aviation and rocket industry. Author (GRA)

N71-22333# Royal Aircraft Establishment, Farnborough (England).
TABLE OF EARTH SATELLITES, VOLUME 2, PART 1, 1969
J. A. Pilkington, D. G. King-Hele, and H. Hiller Jun. 1970 49 p refs
(RAE-TR-70111-Vol-2-Pt-1) Copyright. Avail: NTIS

All known artificial satellites launched between 1 January and 31 December 1969 are listed chronologically. Lifetimes, weights, dimensions and orbital details are given for instrumented satellites and their final-stage rockets. Other fragments from satellites are listed without these details. The methods used in compiling the table are described. Author

N71-22492*# Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.
NATURAL ENVIRONMENT SUPPORT FOR SPACE SHUTTLE TESTS AND OPERATIONS
E. A. Carter 13 Apr. 1971 101 p refs
(Contract NAS8-20082)
(NASA-CR-61346) Avail: NTIS CSCL 22A

Methods and facilities expected to be available by 1977 to meet requirements necessary to support the space shuttle tests and operations are outlined. The natural environment interface of the phases of a mission from preliminaries and prelaunch through final approach and landing are discussed. Advanced design and operations concepts which warrant careful consideration and advance planning and development to achieve minimum sensitivity to the natural environment are proposed. Corresponding to the five phases of a mission, a number of events throughout the mission that are sensitive to the natural environment are listed. The observations, predictions, and communications support required to minimize concern and optimize mission success are submitted as well as programming facilities anticipated as the space shuttle operations evolve. Author

N71-22507# Weapons Research Establishment, Salisbury (Australia).
A ROCKETBORNE PHOTOMETRIC OZONE AND TEMPERATURE MEASURING SONDE
C. J. Beach Nov. 1970 36 p refs
(WRE-TN-HSA-179) Avail: NTIS

A photometric ozone and temperature sonde was developed to extend the range of parameters measured by the drop sonde in the upper atmosphere region from 30 to 65 kilometers. The sonde has been successfully flown in rocket trials conducted at Woomera, South Australia during 1969/70. Author

N71-22612*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
THE DETERMINATION OF THE HELIUM SATURATION LEVEL OF AEROZINC-50 AND NITROGEN TETROXIDE
Irwin D. Smith and Richard P. Schroats (Grumman Aerospace Corp.) Washington Mar. 1971 27 p
(NASA-TN-D-6249; MSC-S-244) Avail: NTIS CSCL 22B

Two methods for determining the helium saturation level of Aerozine-50 and nitrogen tetroxide are examined: the bubble-point method for field use and the gas-content method for laboratory use. Data to illustrate the application of the bubble-point method are presented. The gas-content method and the results obtained from its application are discussed. Equations describing the helium content of Aerozine-50 and nitrogen tetroxide as functions of pressure and temperature are also presented. Author

N71-22663*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DEVELOPMENT HISTORY AND FLIGHT PERFORMANCE OF SERT 2 SOLAR ARRAY
Clifford E. Siegert Washington Apr. 1971 30 p refs
(NASA-TM-X-2246; E-6038) Avail: NTIS CSCL 10A

The SERT 2 solar array consists of 33,000 2- by 2-cm N on P silicon cells configured to supply a nominal electrical power at end of mission of 1100 W at 56 V for an ion thruster and 180 W at 28 V for the spacecraft's command system, telemetry system, attitude control system, and secondary experiments. The design and testing of the array was limited to modifications necessary for the SERT 2 mission since similarly designed arrays were flown successfully on several previous missions. The flight performance of the solar array indicated that all requirements for the mission were met. Author

N71-22688# Joint Publications Research Service, Washington, D.C.
DETAILED DESCRIPTION OF LUNOKHOD 1
In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 248 16 Mar. 1971 p 59–74 (See N71-22682 11-30)
Avail: NTIS

The design, control, and scientific experiments of the lunar vehicle, which is part of the Luna 16 lunar station, are described. Topographical and geomorphological features, and chemical composition and physical properties of lunar rock were studied, and observations of outer space were made with an X-ray telescope and radiometer. One TV camera system monitors the landscape in front as the Lunokhod moves, and another obtains a panoramic picture of the surrounding area. The heat regulation system, electric propulsion, and motion control are described. N.E.N.

N71-22968* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SPACECRAFT AIRLOCK Patent
Joseph H. Judd, inventor (to NASA) Issued 4 Jun. 1968 (Filed 26 Jul. 1966) 6 p Cl. 244-1
(NASA-Case-XLA-02050; US-Patent-3,386,685; US-Patent-Appl-SN-56806) Avail: US Patent Office CSCL 22B

A spacecraft airlock is described which permits an occupant of the spacecraft to safely remove himself from the vehicle when the space vehicle is in a spatial environment without subjecting the vehicular environment to the vacuum of space. The airlock chamber has only one open end and requires a minimum expenditure of energy by an individual when going from one area of air concentration to another. The airlock compartment is designed to be easily replaced in the event of structure damage or degradation. D.L.G.

N71-22969* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STATION KEEPING OF A GRAVITY GRADIENT STABILIZED SATELLITE Patent
William H. Phillips, inventor (to NASA) Issued 4 Jun. 1968 (Filed 19 Jan. 1967) 4 p Cl. 244-1
(NASA-Case-XLA-03132; US-Patent-3,386,686; US-Patent-Appl-SN-610728) Avail: US Patent Office CSCL 22B

A method of station keeping is described for lenticular gravity-gradient stabilized satellites which utilize radiation pressure and the earth's magnetic field for proper location of the satellite. With the proposed method, proper mass distribution provides a preferred orientation in yaw such that the period of oscillation of the satellite in yaw is twice the orbital period. The yaw oscillations permit the forces due to radiation pressure from the sun to feed energy into the orbit on both half cycles. A current-carrying coil is located in the plane of the solar sail and interacts with the earth's magnetic field to produce torque about the Z-axis of the satellite and is controlled by ground command. Alteration of the current direction effects modification of the orientation period and thereby permits control of the energy fed into the orbit to permit station keeping. Official Gazette of the U.S. Patent Office

N71-22970*# National Aeronautics and Space Administration, Washington, D.C.
STRUCTURAL DESIGN CRITERIA APPLICABLE TO A SPACE SHUTTLE. NASA SPACE VEHICLE DESIGN CRITERIA
Jan. 1971 84 p
(NASA-SP-8057) Avail: NTIS CSCL 22B

Structural design criteria and interpretive information are presented for the structural design of an earth-to-orbit space shuttle vehicle. The criteria and supporting information apply to all phases of the shuttle life, independent of external vehicle

configuration. Separate sections deal with: (1) design objectives, (2) design characteristics, (3) design conditions, (4) natural and man-made environments, and (5) proof of design. D.L.G.

N71-23008* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LATERAL DISPLACEMENT SYSTEM FOR SEPARATED ROCKET STAGES Patent
Willard S. Blanchard, Jr., inventor (to NASA) Issued 21 May 1968 (Filed 6 Sep. 1966) 5 p Cl. 102-49.5
(NASA-Case-XLA-04804; US-Patent-3,384,016; US-Patent-Appl-SN-577546) Avail: US Patent Office CSCL 22B

The application of shaped charges for laterally displacing rocket stages after separation is discussed. The shaped charges are mounted on the side of one of the stages to impart an instantaneous sideward force for moving the stages. The shaped charge effect creates an opening in the stage side which permits residual outgassing as well as reducing the possibility of collision between consecutive stages. Official Gazette of the U.S. Patent Office

N71-23009* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
APPARATUS PROVIDING A DIRECTIVE FIELD PATTERN AND ATTITUDE SENSING OF A SPIN STABILIZED SATELLITE Patent
Abe Kampinsky, inventor (to NASA) Issued 12 Sep. 1967 (Filed 23 Jul. 1965) 13 p Cl. 244-1
(NASA-Case-XGS-02607; US-Patent-3,341,151; US-Patent-Appl-SN-474531) Avail: US Patent Office CSCL 22B

A satellite, adapted to spin about an axis, having antenna elements for communicating with a remote body and a beam collimator rotatable with respect to the spin axis is discussed. The beam collimator is rotated at the same rate and in the opposite direction as the spin of the satellite to provide a directional beam stationary in space. Ejection apparatus enables the collimator to be jettisoned in event of rotational malfunction so that an omnidirectional beam may be provided about the spin axis. Signal processing circuitry operating in conjunction with the antenna elements provides information concerning the attitude of the satellite. Official Gazette of the U.S. Patent Office

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N71-21864# North Carolina State Univ., Raleigh.
AN ASPECT OF ENERGY TRANSFER IN AXIAL IMPACT OF RODS
Yasuyuki Horie Sep. 1970 16 p refs
(Contract N00014-68-A-0187)
(AD-717323; TR-70-6) Avail: NTIS CSCL 20/11

Using a bi-linear stress-strain relation, the author has shown that dynamic elastic-plastic transition can be considered as a change in the mode of transfer of conservative energies. The conclusion supports Gilmans view that plastic flow is a transport phenomenon, and suggests that material responses to impact can be characterized by a single diffusion-like coefficient. Author (GRA)

N71-21867# Watervliet Arsenal, N.Y.
ELASTIC PLASTIC ANALYSIS OF OPEN END, TRANSVERSELY ISOTROPIC TUBES UNDER INTERNAL PRESSURE. PART 3: STRAIN SOLUTION BY DEFORMATION THEORY
Peter C. T. Chen Oct. 1970 29 p refs
(AD-717300; WVT-7009) Avail: NTIS CSCL 20/11

The report contains an elastic-plastic analysis of a circular, open-end, unrestricted tube subjected to internal pressure of sufficient magnitude to cause plastic deformation. The axial stress is assumed to vanish identically throughout the tube. The material is homogeneous but transversely isotropic about the radius vector in both elastic and plastic regions. In the plastic portion, Hills orthotropic yield criterion and the associated deformation theory is used. Expressions for strain components are obtained and the results are shown graphically. Author (GRA)

N71-21868# Watervliet Arsenal, N.Y.
FATIGUE CRACK TOLERANCE IN THICK WALLED CYLINDERS
Joseph F. Throop Nov. 1970 41 p refs
(AD-717301; WVT-7035) Avail: NTIS CSCL 20/11

A K-calibration for part-through wall cracks of semi-elliptical shape in a pressurized thick walled cylinder is obtained in two parts which include the stress gradient in the tube wall and the effect of the pressure acting within the crack cavity. Using K in a limiting condition, the calibration provides a failure criterion for estimation of critical crack depths for brittle fracture. The dispersion in crack tolerance may be estimated from the distribution in tempering temperatures among the forgings. This employs the relationships of the mechanical properties to tempering temperature. Author (GRA)

N71-21869# Watervliet Arsenal, N.Y.
ON THE FORCED TORSIONAL VIBRATIONS OF AN ENCASED HOLLOW CYLINDER OF FINITE LENGTH
Gary L. Anderson Nov. 1970 28 p refs
(AD-717302; WVT-7056) Avail: NTIS CSCL 20/11

A hollow isotropic elastic cylinder of finite length is encased in a thin isotropic elastic shell. The lower end-section of the cylinder is fixed, and a time dependent displacement is prescribed at the upper end section. The inner and outer curved surfaces of the system are traction free, but the displacement and the stresses are assumed to be continuous at the interface between the core and the casing. In order to satisfy the differential equation and the boundary conditions, which include derivatives of the dependent variable with respect to time, associated with the forced torsional motion of the system, a modified Fourier-Bessel analysis is employed. The resulting representation of the circumferential displacement may be differentiated term by term to yield expressions for the shear stresses. Author (GRA)

N71-21908# Naval Ship Research and Development Center, Washington, D.C.
THE UNSTEADY LIFT FORCE ON A RESTRAINED HYDROFOIL IN REGULAR WAVES
John M. Steele, Jr. Nov. 1970 30 p refs
(AD-717338; NSRDC-3386) Avail: NTIS CSCL 13/10

The unsteady lift forces on a restrained hydrofoil in regular head and following waves of various wave lengths were measured at the steady zero lift angle, two submergence depths, and several foil speeds. A comparison of the experimental forces with linearized unsteady and quasi-steady theoretical forces revealed inadequacies in both theories. Author (GRA)

N71-21917# North Carolina State Univ., Raleigh.
EXPERIMENTALLY DETERMINED PLASTIC WAVE VELOCITIES IN POLYCARBONATE (LEXAN): STRIKER VELOCITY 1071 FT/SEC TO 1810 FT/SEC
W. L. Liddell, R. S. Steele, W. L. Bingham, and R. A. Douglas Dec. 1970 41 p refs
(Contract N00014-68-A-0187)

(AD-717327; TR-70-10) Avail: NTIS CSCL 20/11

A previously-reported experimental system for determining the large axial strains, surface rotations, strain rates, and plastic wave velocities during axial impacts at striker velocities up to 2000 ft/sec has been further developed, and is used to investigate the behavior of polycarbonate (Lexan) under high-speed impact. The system employs in-surface diffraction grating strain transducers illuminated with a pulsed ruby laser, with the strain-surface rotation-time-dependent diffraction pattern recorded by high-speed streak cameras. Strain-time and plastic wave velocity-strain data are presented for axial impacts of polycarbonate rods at striker velocities ranging from 1071 ft/sec to 1810 ft/sec. Strains in excess of 20 percent with strain-rates in excess of 16,000/sec have been recorded, as well as wave velocities to 7500 ft/sec. Author (GRA)

N71-21933# General Dynamics Co., Groton, Conn. Electric Boat Div.

USER'S MANUAL FOR INT-DDAM. AN INTERACTIVE TIME-SHARING COMPUTER PROGRAM FOR THE DYNAMIC DESIGN ANALYSIS METHOD

Richard G. Gauthier Dec. 1970 153 p refs

(Contract Nonr-4466(00))

(AD-717650; U411-70-022) Avail: NTIS CSCL 13/13

INT-DDAM is a program for the dynamic design/analysis of structures composed of beams and/or springs. It can accommodate up to 120 static degrees of freedom and up to 48 dynamic degrees of freedom. Input consists of joint coordinates, material properties, member cross sectional properties, joint connection data, mass data and base accelerations. Output consists of all input, the overall structural stiffness matrix, the dynamic flexibility matrix, natural frequencies, mode shapes, modal weights, inertial forces, modal joint displacements and member forces, deflections and stresses. Author (GRA)

N71-21942 Colorado Univ., Boulder.

A FINITE ELEMENT ANALYSIS FOR DYNAMIC BEHAVIOR OF STIFFENED PLATES

Shreeram Kashinath Damle (Ph.D. Thesis) 1969 200 p

Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 70-5837

A finite element formulation for the analysis of eccentrically stiffened rectangular plates subjected to dynamic loading is presented. A continuous stiffened plate structure is assumed to be composed of a finite number of plate and stiffener elements interconnected at a finite number of nodes. The finite element method idealizes the actual physical structure more closely by considering the discrete nature of the stiffeners than many of the analytical approaches which assume the stiffener properties to be distributed uniformly over the surface of the plate. The discretization of the structure reduces the governing differential equations of motion to a set of simultaneous, linear, second order ordinary differential equations. Appropriate displacement functions are assumed to define uniquely the in-plane and transverse displacements within each finite element. Elastic, small deflection theory is used. Stiffness and mass matrices and a set of nodal forces equivalent to the applied load (force or mass) acting at any point of the element at any arbitrary time are obtained. Dissert. Abstr

N71-22074 Vanderbilt Univ., Nashville, Tenn.

A TECHNIQUE FOR THE FINITE ELEMENT ANALYSIS OF LARGE COMPLEX STRUCTURAL SYSTEMS

Thomas Sebastian Tarpy, Jr. (Ph.D. Thesis) 1969 224 p

Avail: Univ. Microfilms: HC $10.15/Microfilm $3.00 Order No. 70-5468

A computer programming technique is presented for determining displacements and stresses of large complex structural systems. The analysis is based on the finite element technique whereby the original structural system is idealized into an assembly of discrete elements interconnected at discrete nodes. Utilizing the direct stiffness method of analysis coupled with substructure recursive relations, the resulting equilibrium equations are organized into half-band form, expressed in linear arrays and solved using Cholesky's method for positive definite matrices. As most structural systems can be represented by an assembly of beam and triangular elements, the finite elements available in the computer program are the beam element and the nonconforming triangular flat plate element with or without bending. To illustrate the flexibility of the computer program several example problems are given comparing the accuracy of the finite element technique with other known experimental or analytical solutions. Dissert. Abstr.

N71-22108 Vanderbilt Univ., Nashville, Tenn.

A FINITE ELEMENT TECHNIQUE FOR ANALYZING FOLDED PLATE TYPE STRUCTURES WITH SKEWED SUPPORTS

Dewey Harper Deason (Ph.D. Thesis) 1969 136 p

Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 70-5444

A finite element technique is developed for analyzing folded plate structures with skewed end diaphragms. The basic element used consists of a constant strain membrane element combined with a nonconforming bending element. A transformation and assemblage technique is developed in which the vectors for the nodes lying along the foldlines are rotated into a global coordinate system and the nodal vectors lying along the skew diaphragm are rotated into skew coordinate systems. The individual element stiffness and load vectors at interior node points in their local coordinate system are summed into the overall structural stiffness and load matrices. The basic convergence characteristic for the element is demonstrated by comparing results with two example problems taken from the literature. The general method, including the skew transformations, are demonstrated by comparing theoretical results with results from experiments performed on two aluminum models with skewed end diaphragms. Dissert. Abstr.

N71-22133# Watervliet Arsenal, N.Y.

ELASTIC PLASTIC ANALYSIS OF OPEN END, TRANSVERSELY ISOTROPIC TUBES UNDER INTERNAL PRESSURE. PART 2: STRAIN SOLUTION BY FLOW THEORY

Peter C. T. Chen Oct. 1970 31 p refs

(AD-717299; WVT-7008) Avail: NTIS CSCL 20/11

The report contains an elastic-plastic analysis of a circular, open-end, unrestricted tube subjected to internal pressure of sufficient magnitude to cause plastic deformation. The axial stress is assumed to vanish identically throughout the tube. The material is homogeneous but transversely isotropic about the radius vector in both elastic and plastic regions. In the plastic portion, Hills orthotropic yield criterion and the associated flow theory is used. Expressions for the strain components are obtained, and the results are shown graphically. GRA

N71-22134# Boeing Scientific Research Labs., Seattle, Wash. Mathematical and Information Sciences Lab.

A REVIEW OF MINER'S RULE AND SUBSEQUENT GENERALIZATIONS FOR CALCULATING EXPECTED FATIGUE LIFE

Sam C. Saunders Dec. 1970 20 p refs

(AD-717283; DI-82-1019) Avail: NTIS CSCL 20/11

The paper re-examines the physical assumptions which were made by the originators of the Miner-Palmgren Rule for the calculation of fatigue life and cites publications which show that these assumptions, called the linear cumulative damage hypotheses, are contrary to our present knowledge about actual fatigue behavior. However, work is also discussed which provides evidence that Miners Rule is better on the average in engineering applications

than any other rule for fatigue life which has been advanced. The recent technical papers which resolve this supposed contradiction are referenced and the implications of their results explained in full detail. Author (GRA)

N71-22140# Naval Postgraduate School, Monterey, Calif.
INVESTIGATION OF SURFACE MOTION IN SOLIDS CAUSED BY REFLECTION OF AN INTENSE ACOUSTIC PULSE AT A PRESSURE RELEASE SURFACE
Mustafa Dogusal (M.S. Thesis) Dec. 1970 49 p refs
(AD-717608) Avail: NTIS CSCL 20/12

The report contains theoretical investigations of the surface motion in solids caused by reflection of an intense acoustic pulse at a pressure release surface done using the surface velocity reflection coefficient. A formula was derived for the surface velocity reflection coefficient which relates the surface particle velocity for an incident compression wave to the particle velocities of the incident and reflected waves. To obtain the surface profiles, two different assumptions were used. The first assumption was the conventional one. In this assumption, surface motion was neglected during the period that the pulse strikes the surface and it is called the fixed surface approximation. The second assumption is to consider the motion and distortions of the surface and is called the moving surface approximation. Four different materials were investigated and the results were compared for different materials and in the two different approximations. Author (GRA)

N71-22167# Alabama Univ. Research Inst., Huntsville.
THE FINITE ELEMENT ANALYSIS OF A THICK SHELL OF REVOLUTION
T. J. Chung and M. A. Bandy Oct. 1970 65 p refs
(Contract F44620-69-C-0124)
(AD-717767; UARI-RR-89; AFOSR-70-2868TR) Avail: NTIS CSCL 20/11

The report describes a new method of treating the transverse shear in a thick shell of revolution by the finite element method. Instead of introducing two usual shear strains, meridional and tangential, in addition to three membrane strains and three bending strains, the first derivatives of these shear strains are simply added to appropriate bending strains. A linear variation of shear strains, meridional and tangential displacements, and a cubic variation of transverse displacement are assumed over the finite element. The generalized displacements include a total of six components: meridional displacements, tangential displacement, transverse displacement, meridional curvature, meridional rotation, and tangential rotation. The last two rotation components contain terms associated with the shear strains. A semispherical shell is solved to verify the theory and coding. The results indicate consistently less displacements than those analyzed by a thin shell theory. Author (GRA)

N71-22168# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATIONS OF STRAINS AND STRESSES BY MEANS OF MOIRE PATTERNS [ISSLEDOVANIYA DEFORMATSII I NAPR YAZHENII METODOM MUAROVYKH POLOS]
I. P. Sukharev et al. 9 Dec. 1970 182 p refs Transl. into ENGLISH from the Russian
(AD-717826; FTD-HC-23-614-70) Avail: NTIS CSCL 20/11

The report contains a discussion of the theoretical principles, experimental procedure and the application of a new experimental method for studying strains and stresses of machine parts and structural elements in which the moire effect is used. The method permits experimental solution of a broad class of problems. It has a number of advantages over other techniques and is distinguished by simplicity of the experimental procedure and equipment. Application of the method for studying plates and membrances is discussed in greatest detail. Examples are presented from machine and aircraft building and construction practice. Author (GRA)

N71-22179# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugzeugbau.
THE INFINITELY LONG, VISCOELASTIC, HOLLOW CYLINDER ENCASED IN AN ELASTIC CYLINDRICAL SHELL. QUASI-STATIC CALCULATION OF STRESSES AND STRAINS DUE TO INTERNAL PRESSURE AND AN ABLATING INNER BOUNDARY [DER UNENDLICH LANGE, VISKOELASTISCHE HOHLZYLINDER IN EINER ELASTISCHEN ZYLINDERSCHALE. QUASI-STATISCHE BERECHNUNG VON SPANNUNGEN UND DEHNUNGEN UNTER INNENDRUCK UND BEI ABBRAND]
D. Petersen Jul. 1970 85 p refs In GERMAN; ENGLISH summary
(DLR-FB-70-61) Avail: NTIS; ZLDI Munich: 15,50 DM

The influences of design and material parameters over stresses and strains are systematically investigated. The integral equations resulting from linear theory are solved using Laplace transforms and numerical procedures. The results are discussed in detail and are illustrated by graphs. Author (ESRO)

N71-22202# Joint Publications Research Service, Washington, D.C.
HYDRODYNAMICS OF A THIN, FLEXIBLE BODY (EVALUATION OF HYDRODYNAMICS OF FISH)
G. V. Logvinovich *In its* Hydrodyn. Probl. of Bionics 12 Mar. 1971 p 4-11 refs (See N71-22201 11-05)
Avail: NTIS

The hydrodynamics of a thin, deformed body producing small wave oscillations in steady forward movement, can be studied fairly simply with the plane section method, employing the penetration layer concept. This concept is used to study the swimming mechanism of elongated fish and mammals. A.L.

N71-22236# Naval Postgraduate School, Monterey, Calif.
VIBRATION OF AN ELL SHAPED UNIFORM FILAMENT WITH CLAMPED ENDS
Cetin Derin Dec. 1970 14 p refs
(AD-717496) Avail: NTIS CSCL 20/11

An analysis is made of in-plane and out-of-plane vibrations of a uniform filament which is bent at right angles and the ends of which are fixed. Shear deflection and rotatory inertia are neglected. Curve sheets are presented from which one may find the first several frequencies of vibration in terms of the geometrical and physical variables. An important application is to the vibrations of piping systems. Author (GRA)

N71-22237# Alabama Univ., Huntsville. Research Inst.
ANALYSIS OF FINITE DEFORMATIONS OF ELASTIC SOLIDS BY THE FINITE ELEMENT METHOD
J. T. Oden and J. E. Key Dec. 1970 63 p refs
(Contract F44620-69-C-0124)
(AD-717768; UARI-RR-90; AFOSR-70-2864TR) Avail: NTIS CSCL 20/11

The report is concerned with an extension of previous finite element applications in finite elasticity. Generally, formulations of the equations governing finite deformations of incompressible elastic elements are presented. Formulations of higher order approximations and curvilinear elements are also given. Two types of incompressibility conditions are obtained: one which is applied locally, element by element, and another which is applied at each node in the connected model. Discussions of nonconservative generalized forces and consistent stresses in finitely deformed elements are considered. The incremental loading technique is applied to solve the nonlinear equations for arbitrary forms of strain energy function for isotropic methods. Several numerical examples are presented; these include finite stretching of materially nonlinear sheets, finite deformation of a circular plate, and finite plane strain of a body containing a circular hole. Author (GRA)

N71-22334# Alabama Univ., Huntsville. Research Inst.
NUMERICAL ANALYSIS OF A CONICAL SHELL BY A FINITE ELEMENT MODEL BASED ON THE DISCRETE KIRCHHOFF HYPOTHESIS
George E. Weeks Oct. 1970 35 p refs
(Contract F44620-69-C-0124)
(AD-717770; UARI-RR-92; AFOSR-70-2866TR) Avail: NTIS CSCL 20/11

The linear axisymmetric analysis of a lateral pressure loaded conical shell is presented using a ring type finite element model based on the discrete Kirchhoff hypothesis. The inplane and transverse displacements as well as the rotations at each node are represented by a linear function of the meridional coordinate. The analysis is an extension of earlier work using the same element in the sense that the coupling effect of bending and extension is included. The results of the investigation indicate that the proposed model is capable of accurately describing coupled bending and extension effects. In addition to the numerical results obtained several advantages and disadvantages of this element are brought out. In particular, the element stiffness coefficients can be derived easily because of the simplicity of the assumed vector field. However, it appears that the price paid for such a simple vector field approximation is an undue amount of machine storage and execution time, even for a relatively small number of elements. Several suggestions are made for minimizing some of these difficulties. Author (GRA)

N71-22337# Alabama Univ. Research Inst., Huntsville.
BUCKLING ANALYSIS OF AN ARBITRARY SHELL BY CURVED TRIANGULAR ELEMENTS
T. J. Chung and J. K. Lee Oct. 1970 51 p refs
(Contract F44620-69-C-0124)
(AD-717766; UARI-RR-87; AFOSR-70-2869TR) Avail: NTIS CSCL 20/11

The report is concerned with application of the curved triangular finite elements in the buckling analysis of an arbitrary shell. The linear membrane displacements and quintic transverse displacements are assumed and these displacement fields are coupled through the surface curvature transformation and the local-global base coordinate transformation. An iterative eigenvalue solution scheme is used to determine critical loads. As examples doubly curved shells are analyzed and their results presented. As a special case the computer program can be reduced to handle buckling of plates. Author (GRA)

N71-22366# Indian Inst. of Science, Bangalore. Dept. of Aeronautical Engineering.
DESIGN DATA ON BUCKLING OF SIMPLY SUPPORTED SKEW PLATES (ORTHOGONAL COMPONENTS). PART 2: COMBINED LOADING
Mahabaliraja and S. Durvasula Jan. 1971 93 p refs
(AE-290-S) Avail: NTIS

Buckling under combined loading of simply supported skew plates is considered with the in-plane stresses expressed in terms of orthogonal components. Rayleigh-Ritz method is applied expressing the deflection in terms of a double Fourier series of sine functions. The numerical results are presented in the form of tables and interaction curves/surfaces which should be of value in design. Several interesting features associated with the skew geometry as well as the buckling behavior under combined loading are also discussed. Author

N71-22367# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Materials Lab.
GEOMETRIC DESIGN OF COMPOSITE CYLINDRICAL CHARACTERIZATION SPECIMENS Technical Report, Jan. - Apr. 1970
N. J. Pagano and J. M. Whitney Nov. 1970 43 p refs
(AD-717700; AFML-TR-70-130) Avail: NTIS CSCL 20/11

The stress field within a highly anisotropic cylinder, even under simple loading conditions, is far from uniform. Thus, like other verbiage which has its origins in the stress analysis of isotropic bodies, the terminology thin-walled cylinder must be redefined for anisotropic materials, and is a strong function of elastic moduli. This places a severe burden on the experimentalist who must employ such specimens to characterize composite materials under biaxial states of stress. In this work, a procedure is outlined to determine the proper geometry of anisotropic and laminated cylinders such that elastic stress gradients can be reduced to a predetermined limit. The approach consists of combining a modified plane strain elasticity solution with shell theory. Parametric studies on materials possessing high and low degrees of anisotropy indicate general guidelines for proper tube geometry for precise characterization under simulated laboratory loading and clamping conditions. Author (GRA)

N71-22400# Central Lab. TNO, Delft (Netherlands).
CALCULATION OF ELASTIC PROPERTIES OF COMPOSITES BY MEANS OF THE VAN DER POEL THEORY
F. R. Schwarzl and J. v. d. Eikhoff Feb. 1971 57 p refs
Sponsored in part by ONR
(Contract F61052-67-C-0059)
(CL-71/55; ONR-TR-9) Avail: NTIS

Van der Poel's theoretical model for the calculation of shear modulus, bulk modulus, and thermal expansion behavior of two-phase composite materials is analyzed, and the model is generalized for arbitrary elastic constants of the constituents. Results are presented in explicit form, and a computer program for the performance of the necessary calculations is presented. Results for the shear moduli of the composite materials are discussed and compared with results of measurements on the composite system polyurethane rubber-sodium chloride. Author

N71-22473# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE BIFURCATION OF THE EQUILIBRIUM STATE OF A THREE DIMENSIONAL ISOTROPIC ELASTIC SOLID UNDER LARGE SUBCRITICAL DEFORMATIONS
A. N. Guz 1970 16 p refs Transl. into ENGLISH from PPM (Moscow), v. 34, no. 6, 1970 p 1113-1125
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

Forms of the elastic potential were applied in the linearized equation derivation in displacements for arbitrary subcritical deformations and in problem solving for a three dimensional elastic isotropic solid. The linearized equations in displacements for an arbitrary form of the elastic potential were obtained, and a number of problems were considered in such an approach. Author

N71-22477 Laboratorium fur Betriebsfestigkeit, Darmstadt (West Germany).
CYCLIC PLASTIC DEFORMATION AND THE STRAIN CONCENTRATION FACTOR [PLASTISCHE WECHSELVERFORMUNG UND DEHNUNGSFORMZAHL]
K. Wellinger et al Dec. 1969 32 p refs Transl. into ENGLISH from VDI Berichte (Dusseldorf), no. 129, 1968
(TUE-84(1970) Copyright. Avail: Issuing Activity

At the notch root of centrally notched flat specimens the maximum strain in the transverse direction was determined by means of a specially designed lateral extensometer. Measurements on plain cylindrical specimens yielded the relationship between longitudinal and transverse strain as a function of total strain. The relationship obtained was used to convert the maximum values of transverse strain on flat plate notched specimens into corresponding values of longitudinal strain at the notch root and thus to determine the strain concentration factor. This strain concentration factor

served to determine the number of cycles to crack initiation for notched specimens from the curve of plain specimens established at constant strain levels. Author

N71-22483 Ohio State Univ., Columbus.
WARPING TORSION IN CURVED BEAMS OF H-SECTION
John Thomas Wilson (Ph.D. Thesis) 1969 79 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 70-6917

Two methods of analysis are used to express the warping torsion of curved beams of H-section. One, due to V. Z. Vlasov, is an extension of straight member warping torsion theory to the curved member case. The other method, proposed by Goldbert and Bogdanoff, applicable to members of wide flange cross section, considers the cross section to be made up of several thin rectangular elements. Twenty-one tests on circularly curved, four inch, H-section beams are reported. The radii of the beams varied from 50 inches to 80 inches and the subtended angle varied from 68 degrees to 115 degrees. Of the two methods studied, the Goldberg-Bogdanoff method gave results which conformed more closely to the experimental results. However, it was found that even this method of analysis can be expected to predict deflections and rotations which vary as much as 10% from the true deflections and rotations. It was concluded that until a more accurate method of analysis is developed, the use of the Goldberg-Bogdanoff method is recommended. Dissert. Abstr.

N71-22484# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON ELASTICITY RELATIONSHIPS IN THE LINEAR THEORY OF THIN ELASTIC SHELLS
E. M. Zveriaev 1970 5 p refs Transl. into ENGLISH from PMM (Moscow), v. 34, no. 6, 1970 p 1136–1138
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

Questions of constructing tensor elasticity relationships within the accuracy of the Kirchhoff-Love hypotheses are discussed. It is shown that it is impossible to conserve simultaneously the static-geometric analogy and to assure application of elasticity theory theorems by using simple elasticity relationships. Two modifications of the elasticity relationships in the linear theory of thin elastic shells are proposed. The first modification retains the elasticity theory theorems in the linear theory of thin elastic shells. The second modification satisfies the demands of the static-geometric analogy, but spoils the reciprocity theorem. Author

N71-22485# California Univ., La Jolla. Dept. of the Aerospace and Mechanical Engineering Sciences.
A KOITER TYPE METHOD FOR FINITE ELEMENT ANALYSIS OF NONLINEAR STRUCTURAL BEHAVIOR. VOLUME 1: THE MODIFIED STRUCTURE METHOD Final Report, 17 Oct. 1969 – 17 Oct. 1970
R. T. Haftka, R. H. Mallett, and W. Nachbar Wright-Patterson AFB, Ohio AFFDL Nov. 1970 259 p refs
(Contract F33615-69-C-1899)
(AD-717740; AFFDL-TR-70-130-Vol-1) Avail: NTIS CSCL 20/11

Koiters method for the asymptotic analysis of post-buckling behavior is reformulted in finite element notation for application to structures idealized by finite element models. Koiters method is herein adapted to a general class of structures exhibiting the common snap-through (limit point) type of buckling. This is referred to as the Modified Structure method. It is accomplished by modification of the actual energy functional to create a hypothetical modified structure having a strictly linear pre-buckling path along which buckling must be of the bifurcation type. The analysis of the actual structure is then accomplished by application of Koiters method through consideration of the actual structure as an imperfect version of the modified structure. The effects of pre-buckling nonlinearity are approximated asymptotically. The use of the Modified Structure method in conjunction with direct methods of nonlinear analysis is examined. A highly accurate finite element representation is employed in presenting a comprehensive numerical evaluation of the Modified Structure method of analysis on the basis of a number of planar frame problems. Author (GRA)

N71-22495# Lockheed Missiles and Space Co., Palo Alto, Calif.
METHODS OF SOLVING SHELL STABILITY THEORY PROBLEMS
A. V. Karmishin et al 1970 18 p refs Transl. into ENGLISH from Tr. 7 Vsesoiuznoi Konf. po Teorii Obolocher i Plastinok (Moscow), 1970 p 794–807
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

A narrow class of methods to determine the carrying capacity of thin walled structures is examined, namely, numerical algorithms to solve problems of the elastic stability of thin-walled axisymmetrically loaded shells of revolution based primarily on finite-difference schemes. A survey of results using the algorithms is presented for cylindrical shells under axial compression, uniform and nonuniform external pressure, and axisymmetrical and combined loads as well as for conical, spherical, and toroidal shells. Author

N71-22499# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON A MEMBRANE THEORY OF ANISOTROPIC SHELLS
S. A. Ambartsumian 1970 12 p refs Transl. into ENGLISH from PMM (Moscow), v. 34, no. 6, 1970 p 1120–1135
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The question of constructing a membrane theory of anisotropic shells by reducing the three dimensional problem of the theory of elasticity of an anisotropic body to a two dimensional problem of shell theory is considered. Special attention is turned to those stresses which are not the subject of discussion in the classical theory of anisotropic shells. Some analytical criteria for a shell to be a membrane are proposed. Author

N71-22504 National Lending Library for Science and Technology, Boston Spa (England).
APPARATUS FOR TENSILE TESTING OF MICROSPECIMENS IN THE LOW TEMPERATURE CHANNEL OF A REACTOR
I. A. Naskidashvili et al [1970] 7 p refs Transl. into ENGLISH from Atomnaya Energ. (Moscow), v. 28, no. 1, Jan. 1970 p 55–58
(NLL-Risley-Trans-1958-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The temperature dependence of the radiation effect on the physical and mechanical properties of metals was studied over a wide range of temperature in the cold channel of a nuclear reactor. It was found that the neutron irradiation of commercially pure aluminum enhances its ultimate strength by 12%, and the yield strength by 16.5%. F.O.S.

N71-22508# Aeronautical Research Inst. of Sweden, Stockholm.
FATIGUE CYCLING OF RIVETED OR BOLTED JOINTS
Lars Jarfall Jun. 1969 63 p refs Supported by Swed. Board for Tech. Develop.
(HF-1239 Avail: NTIS

Some short test series with various configurations of riveted or bolted joints were cycled to study their fatigue life and their deformation as influenced by various parameters. It was found that the fatigue strength of a joint is influenced by the local load transfer at the critical fastener in reasonable agreement with the linear approach of the stress severity factor concept. Although the fastener flexibility as defined by the bolt constant was found to

vary with the amount of load transfer as well as with the number of applied load cycles, it was demonstrated that the amount of local load transfer in a redundant structure may be calculated, if data from deflection measurements on simple joint specimens are known. Deflection measurements for determination of bolt constants were carried out for ten different configurations of fasteners and plates. Author

N71-22517# Northwestern Univ., Evanston, Ill. Dept. of Civil Engineering.
THE LAYERED MEDIUM AS A HOMOGENEOUS CONTINUUM WITH MICROSTRUCTURE Technical Report, 1 Feb. 1969 – 30 Jun. 1970
Jan D. Achenbach Wright-Patterson AFB, Ohio AFML Dec. 1970 43 p refs
(Contract F33615-68-C-1290)
(AD-717731; AFML-TR-70-275) Avail: NTIS CSCL 20/11

A homogeneous continuum model is developed to describe the mechanical behavior of a laminated composite consisting of alternating layers of two homogeneous anisotropic elastic solids. The theory is based on two-term expansions of the displacements across the thicknesses of the layers. The transition from the discrete system of layers to a homogeneous continuum is achieved by introducing three fields to describe the state of deformation: gross displacements, and local deformations in the reinforcing and the matrix layers, respectively. Balance equations and constitutive relations for the stress resultants and the first moments of the stresses across the thicknesses of the layers are also derived. It is shown that the effective modulus theory is a special case of the theory presented herein. Various applications of the theory are briefly discussed. Author (GRA)

N71-22535# Technion-Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.
NOTCH AND SIZE EFFECT IN FATIGUE OF ELEMENTS WITH TRANSVERSE HOLES
Alfred Buch Oct. 1970 32 p refs
(TAE-114 Avail: NTIS

A physical and analytical approach to the notch and size effect is considered as an extension of Peterson's theory. It was confirmed for round normalized steel specimens and flat steel and aluminium alloy specimens with central holes and showed good agreement with fatigue test results. A notch sensitivity factor, suitable for comparing different materials, is proposed. This factor yields better results than Peterson's q-factor in the case of specimens with central holes. Author

N71-22586# Sandia Corp., Albuquerque, N.Mex.
STRAIN HARDENING AND STRAIN RATE IN ONE DIMENSIONAL WAVE PROPAGATION CALCULATIONS
W. Herrmann, R. J. Lawrence, and D. S. Mason Nov. 1970 119 p refs
(SC-RR-70-471) Avail: NTIS

A discussion is given of the implementation of anisotropic strain hardening and of stress relaxation in one-dimensional Lagrangian finite-difference methods for the calculation of elastic-plastic stress wave propagation. Methods are given for the deduction of appropriate strain hardening and stress relaxation functions from stress-wave experiments. Program listings for a subroutine for use with the computer program WONDY are included. Author

N71-22617*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECT OF STATIC STRESS AND EDGE RESTRAINT ON THE VIBRATION OF NEARLY CYLINDRICAL SHELLS WITH CIRCULAR CROSS SECTION
Paul A. Cooper and Martha P. Robinson Washington Apr. 1971 38 p refs
(NASA-TN-D-6133; L-7024) Avail: NTIS CSCL 20K

The effect of stress due to statically applied axial compressive and tensile loads and external or internal pressure on the minimum natural frequencies of freely supported nearly cylindrical shells with circular cross section and slight meridional curvature is investigated. Also the effect of various edge restraints on the natural vibration of unstressed nearly cylindrical shells is investigated. Results show that axial tension loads and external hydrostatic pressure can cause sizable reductions in minimum frequencies for positive Gaussian curvature shells. While axial compression loads and internal pressure increase the frequencies for these shells, the compression loading increases frequencies only slightly before onset of static instability. In contrast, negative curvature shells are highly sensitive to axial compression and external hydrostatic pressure and evidence large reductions in frequencies at low load levels. Both axial tension and internal hydrostatic pressure cause large increases in frequencies in negative-curvature shells, but generally not higher than similarly loaded cylinders. The minimum frequencies of negative-curvature shells are sensitive to the degree of meridional in-plane restraint at the shell edges, with large increases occurring when the edges are completely restrained, whereas they are relatively insensitive to slope restraint at the edges. The minimum frequencies of positive curvature shells, on the other hand, are relatively insensitive to both in-plane and slope restraints. Author

N71-22714 Alabama Univ., University.
NON-HERTZIAN CONTACT STRESSES BETWEEN CYLINDERS OF DISSIMILAR CROSS SECTION
Charles Henry Ratcliff (Ph.D. Thesis) 1969 83 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 70-9376

Methods utilizing analytic function theory, superposition, and point matching are employed to determine the stresses and displacements in smooth parallel contacting cylinders. The cross-sections of the cylinders have two axes of symmetry, and alternating cylinders are of the same material and have identical geometries. The cylinders are conformally mapped onto unit circles by mapping functions that are approximated by truncated Taylor series. A computer program in FORTRAN 4 language is developed which allows computation of the contact stresses and displacements in smooth parallel contacting cylinders for which the coefficients in the series mapping functions are known. Different configurations are studied for contact areas that are not small compared to the dimensions of the cylinder cross-sections and the surface curvatures vary significantly within the contact zone. It is shown that Hertz theory is inapplicable for such cases. Dissert. Abstr.

N71-22793 Princeton Univ., N.J.
AXIALLY SYMMETRIC WAVES IN HOLLOW ELASTIC CIRCULAR CYLINDERS SUBJECTED TO STEP FUNCTION LOADING
Ken-pin Chong (Ph.D. Thesis) 1969 87 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 70-8355

Axisymmetric waves in semi-infinite hollow elastic cylinders, with traction-free lateral surfaces and a pressure-step loading applied normally at a finite end, are considered on the basis of equations of motion. Using double-integral transforms, asymptotic solutions are obtained as functions of time and of radial and longitudinal distance, for strains and stresses in terms of material and geometric parameters. Pulse head arrival times at the same station for various thickness ratios, as well as for different stations with the same thickness ratio, are presented. It is noted that for thin cylinders there exist group velocities of the radial mode (second branch) which are higher than those of the longitudinal mode (first branch) although none of them exceed the normalized dilatational velocity. Dissert. Abstr.

N71-22885 Alabama Univ., University.
THERMOMECHANICAL COUPLING PHENOMENA IN NONISOTHERMAL VISCOELASTIC SOLIDS
Thomas Lee Cost (Ph.D. Thesis) 1969 130 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 70-9340

The increasing use of viscoelastic materials in cyclic loading applications has created a need for an understanding of the thermomechanical coupling phenomenon by which mechanical energy exerted in deforming a material is converted into thermal energy. Three basic approaches to a mathematical analysis of this phenomenon are reviewed and discussed in as similar a mathematical notation as possible. The basic constitutive behavior, including dissipative effects, of thermorheologically simple materials is developed. The significance of the derived dissipation function is investigated by solving the energy equation, with the dissipation function included, for the case of a solid circular cylinder undergoing torsional vibrations. An experiment was performed on a solid circular cylinder of a polyurethane rubber by applying a periodic torsional displacement to one end of the cylinder while holding the other end fixed. Results indicate that the heat generated in viscoelastic materials by cyclic loading at frequencies of about 10 Hz and strain magnitudes of about 5% can produce temperature changes of at least 30 F. Dissert. Abstr.

N71-22891 Purdue Univ., Lafayette, Ind.
THEORETICAL STUDY OF LANDING MAT BEHAVIOR
John Christopher Rosner (Ph.D. Thesis) 1969 198 p
Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 70-8962

Mechanistic models are developed to help predict the behavior of landing mat systems. The first model, which is based upon elastic theory, is capable of duplicating the action of such systems under static loads. The associated assumptions are: (1) that an infinite beam is the structural equivalent of the mat; (2) that the subgrade is homogeneous; (3) that horizontal displacements within the subgrade are negligible; and (4) that the mat always remains in contact with the subgrade. The model parameters are established from simulations of full-scale experimental tests. These parameters are also correlated with prototype test variables. Results from prototype tests indicate that the model parameter k, the subgrade modulus, decreases as trafficking of the section progresses. Contrary to common belief the model behavior is found to be extremely sensitive to the magnitude of the subgrade modulus. Dissert. Abstr.

N71-23004 New York Univ., N.Y. School of Engineering and Science.
A STUDY OF THE ELASTIC AXISYMMETRIC BEHAVIOR OF CYLINDERS WITH APPLICATIONS
Robert Frank Melworm (Ph.D. Thesis) 1969 203 p
Avail: Univ. Microfilms: HC $9.25/Microfilm $3.00 Order No. 70-9784

The small displacement, elastic, time independent torsionless axisymmetric behavior of cylinders is discussed. Two general theories are used to formulate the cylinder problem. First, mathematically rigorous elasticity theory is considered. The solution of the elasticity equations by the use of functions implicitly defined in terms of the displacement components are considered. Application of this approach to torsionless-axisymmetric cylinder problems is systematically presented. Second, structural theory is considered. Classical structural assumptions are used to consistently obtain elastic shell theories. In the formulation, the ratio of the cylinder's wall thickness to its mean radius is not neglected in comparison to unity and cognizance is taken of the actual surfaces on which loads are applied. The resulting set of equations are reduced, by consistently neglecting certain powers of the thickness to mean radius ratio as compared to unity, to other governing sets of equations. Dissert. Abstr.

N71-23019 Alabama Univ., University.
THE DYNAMIC RESPONSE OF BEAMS TO TIME VARYING LENGTH
Halsey Eugene Worley, Jr. (Ph.D. Thesis) 1969 80 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 70-9398

A series solution for small-amplitude transverse oscillations of a time-variable length cantilever beam is presented. The formulation of the problem resulted in a fourth-order partial differential equation with variable coefficients and with boundary conditions to be evaluated at positions that are functions of time. The solution to the governing differential equation is obtained by first transforming the independent spatial variable such that the boundary conditions would be evaluated at fixed positions. Then, by the Galerkin technique, the fourth-order partial differential equation was transformed to an infinite set of second-order ordinary differential equations with variable coefficients. An asymptotic solution to this set of equations was obtained in a power series expansion of the mass per unit length divided by the bending stiffness. A solution for arbitrary initial conditions and for constant acceleration of the length is developed through second-order terms. Dissert. Abstr.

N71-23020 Pennsylvania State Univ., University Park.
THE CHARACTERIZATION AND THE STRESS ANALYSIS FOR NONLINEAR ELASTIC MATERIAL
Youngson Lee (Ph.D. Thesis) 1969 156 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 70-7223

Two types of biaxial experiments to characterize Solithane 113 corresponding to time independent mechanical behavior are described. In addition, it covers the stress and deformation analysis of thick wall cylinders made of nonlinear elastic materials subjected to internal pressure. Two types of cylinders were considered, one with a stress free external surface and another reinforced on the exterior surface with a thin-elastic shell. The first type of experiment was conducted under controlled strain rates and the second under controlled stress rates. A method has been described to obtain the strain energy function of the material from these biaxial experimental results. Additional experiments were also conducted on the thick wall cylinders of Solithane 113 with and without external aluminum shell reinforcement when subjected to internal pressure only. The experimental results were found to be in reasonably good agreement with the prediction from the analysis. Dissert. Abstr.

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N71-21962*# McDonnell Aircraft Corp., St. Louis, Mo.
DEVELOPMENT OF A GRAPHITE RADIANT HEATER
F. W. Brodbeck, D. Q. Durant, and R. D. Taylor Washington NASA 31 Dec. 1970 123 p refs
(Contract NAS1-8921)
(NASA-CR-111841) Avail: NTIS CSCL 20M

The performance of graphite radiant heaters as a high heat flux source for thermostructural tests was investigated. The detailed design investigation revealed that the limiting factor was the evolution of smoke which induced electrical arcing. This occurred when the graphite temperature reached approximately 5300 F. This problem was studied extensively to determine the influence of purge gas composition, various grades of graphite, element spacing,

impressed voltage, and element geometry on the maximum operating temperature. Prototype testing demonstrated that a graphite radiant heater can provide an absorbed heat flux of approximately 220 Btu/sq ft-sec to a 2 x 2-foot cold-wall structure. Author

N71-21964# Naval Postgraduate School, Monterey, Calif.
MEASUREMENTS OF THE SPONTANEOUS POLARIZATION KH2PO2
John Wesley Benepe (Ph.D. Thesis) Dec. 1970 89 p refs
(AD-717598) Avail: NTIS CSCL 20/3

Measurements of the spontaneous polarization in KH2PO4 within 1K of the ferroelectric transition are reported. The measurements employed the electrocaloric effect, allowing simultaneous determination of the polarization and its temperature derivative. The derivative computed from polarization measurements compares well with direct determinations of (delta P/delta T)E demonstrating thermodynamic consistency of the measurements. Landau theory allows separate calculation of specific heat contributions of the lattice and polarization and thus the total specific heat, which agrees very well with direct calorimetric determinations, although the decomposition differs from that previously assumed. This indicates that Landau theory provides a good description of the transition in KH2PO4 and that there is a calorimetric anomaly not directly associated with the polarization. The free energy expansion best fitting the data contains P4 and P8 terms and no P6 term. Author (GRA)

N71-22072# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abteilung Heterogene Stroemungen.
MASS TRANSFER INVESTIGATIONS AT A FLAT STATIC LIQUID SURFACE IN PARALLEL AIR FLOW FORMING A LAMINAR BOUNDARY LAYER [UNTERSUCHUNG DES STOFFUEBERGANGS AN EINER EBENEN RUHENDEN FLUESSIGKEITSOBERFLAECHE BEI PARALLELER ANSTROEMUNG UND LAMINARER GRENZSCHICHT]
Klaus-Juergen Schultz Jul. 1970 46 p refs In GERMAN; ENGLISH summary Sponsored by Deut. Forschungsgemeinschaft
(DLR-FB-70-58) Avail: NTIS; ZLDI Munich: 12,30 DM

Some results of the current experimental work which is being done for the determination of the velocity of evaporation of a flat hydrocarbon film in parallel flow, whereby a laminar boundary layer is formed over the liquid surface, are reported. The test layout and performance are described. The dependence of the evaporating mass per unit time and area, averaged over the liquid surface from the velocity and temperature of the flow is presented by means of diagrams for the hydrocarbon benzol and compared with the results of two simplified computation methods. Author (ESRO)

N71-22116# Societe Europeenne d'Etude et d'Integration de Systemes Spatiaux, Courbevoie (France).
EVALUATION OF THERMAL TEST IN SPACE SIMULATION CHAMBER FOR DETERMINATION OF A MATHEMATICAL SATELLITE MODEL. APPENDIX [EXPLOITATION D'UN ESSAI THERMIQUE EN CHAMBRE DE SIMULATION SPATIALE EN VUE DE LA DETERMINATION DU MODELE MATHEMATIQUE D'UN SATELLITE. ANNEXE]
M. Toussaint 26 Sep. 1969 60 p In FRENCH
(Contract ESTEC-624-68)
(NT/D1/69/143) Avail: NTIS

Satellite temperature analysis determined from experiments and its mathematical model were investigated. A satellite model with thermocouples was tested in a space environment simulation chamber. Finally the mathematical model was determined from this scale model as a function of the measured temperatures. In this report only tables and graphs are given. ESRO

N71-22128# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany). Inst. fuer Reaktionskinetik.
COMPARISON OF THEORETICAL AND EXPERIMENTAL REGRESSION RATES FOR THE HYBRID SYSTEM FLOX/POLYETHYLENE [VERGLEICH DES THEORETISCHEN UND EXPERIMENTELLEN ABBRANDVERHALTENS VON FLOX MIT POLYAETHYLEN]
R. Buchheim and R. E. Lo Bad Godesberg, West Ger. Bundesmin. fuer Bildung und Wiss. Dec. 1970 82 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Bildung und Wiss.
(BMBW-FB-W-70-65) Avail: NTIS; ZLDI Munich: 16,80 DM

Experimental regression rates were determined and used to correlate actual data with analytically predicted results. No completely satisfactory correlation resulted, since the theoretical model did not account for the actual injection mechanism. However, a good correlation resulted for various operating variables, using the derived regression law for a five-hole-geometry of the solid fuel and the experimentally determined law for cylinders. Author (ESRO)

N71-22129# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Abteilung Trans- und Ueberschallwindkanaele.
EXPERIMENTAL INVESTIGATIONS ON SUPERSONIC COMBUSTION IN THE FLOW FIELDS OF BODIES OF REVOLUTION AND NEAR A FLAT PLATE IN TANGENTIAL FLOW [EXPERIMENTELLE UNTERSUCHUNGEN ZUR WAERMEZUFUHR IM UEBERSCHALL-STROEMUNGSFELD AN ROTATIONSKOERPERN UND AN DER TANGENTIAL ANGESTROEMTEN PLATTE]
Franz Maurer, Franz-Joachim Niezgodka, and Helmut Post Dec. 1970 77 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Verteidigung
(DLR-FB-70-64) Avail: NTIS; ZLDI Munich: 19,70 DM

Supersonic combustion of hydrogen in the flow field of a flat plate in tangential flow and near bodies of revolution was studied in the Mach number range from 1.8 to 3.2. In the flat plate experiments a secondary air jet from a crosswise slot was used to stabilize the flame. Hydrogen was injected upstream of the slot. Flame stabilization on bodies of revolution was obtained due to a small annular cavity near the thickness maximum. In all cases spark ignition was used. The changes of pressure distribution near the flat plate as well as changes of drag of the bodies of revolution due to heat addition were considerable. Author (ESRO)

N71-22200# National Aeronautical Establishment, Ottawa (Ontario). Flight Research Lab.
THE DEVELOPMENT AND TESTING OF A PYROTECHNIC SEEDING SYSTEM ON A MODIFIED T-33
G. K. Mather *In* NRC of Can. Quart. Bull. of the Div. of Mech. Eng. and the Natl. Aeron. Estab., Oct.–Dec. 1970 31 Dec. 1970 p 39–54 refs (See N71-22198 11-15)
Avail: NTIS

A T-33 aircraft was modified and instrumented to meet the requirements for a seeding aircraft in hail suppression experiments. All systems, including radar, flare fire control, and instrumentation, proved extremely reliable during field tests. The design of the flares proved optimum for the Alberta storms. The chaff flare was useful in gaining confidence in targetting accuracy. Author

N71-22335# International Business Machines S.A.E., Madrid (Spain).
TEMPERATURE VARIANCE IN SPACECRAFT THERMAL ANALYSIS ATV-70 PROGRAM

M. J. de Lucas Jul. 1970 109 p refs
(Contract ESTEC-583-68)
Avail: NTIS

The design of a thermal system is dependent upon the prediction of temperatures and/or heat flow during specified flight missions. In general this requires the generation of a mathematical model and the use of input information which is subject to variances. A method of generating the uncertainty interval of temperatures due to input information variances and the development of a computer program to be applied to a particular mathematical model are presented. Author (ESRO)

N71-22336# International Business Machines S.A.E., Madrid (Spain).

GENERAL REPORT ON IMPLEMENTATION OF THERMAL PROGRAMS IN THE ESTEC SYSTEM FOR THE CALCULATION OF TEMPERATURE DISTRIBUTION BY THE METHOD OF ZONES

A. Hernando and S. Baeza Jul. 1970 64 p refs
(Contract ESTEC-583-68)
Avail: NTIS

The work is centered on the understanding of the method of zones, application of the TTA-27 program (Transient Thermal Analysis) to the configuration of the ESTEC-IBM system and utilization of the several configurations proposed by ESTEC. The theoretical definitions are compared with the practical results obtained from computer runs in order to establish adequate conclusions. Author (ESRO)

N71-22406# Stanford Univ., Calif. Dept. of Mechanical Engineering.

SOME CONTRIBUTIONS TO THE TECHNIQUES FOR TESTING COMPACT HEAT EXCHANGER SURFACES

John H. Stang Dec. 1970 138 p refs
(Contract Nonr-225(91))
(AD-717662; TR-74) Avail: NTIS CSCL 13/1

Two techniques for testing compact heat exchangers are refined. They are the maximum-slope variation of the single-blow transient technique, and the regular periodic technique. The maximum-slope method is improved by using an electronic control to produce a very fast heater response, thereby generating a sharper step change in airstream temperature. The design method for the electronic control is presented along with an experimental verification of its function. Author (GRA)

N71-22494# Glasgow Univ. (Scotland). Dept. of Aeronautics and Fluid Mechanics.

THE ROLE OF HEAT CONDUCTION IN LEADING EDGE HEATING: THEORY AND EXPERIMENT

T. Nonweiler, H. Y. Wong, and S. R. Aggarwal Jun. 1969 62 p refs
(Rept-6901) Avail: NTIS

The effect of heat conduction of material on the temperature distribution in the vicinity of a wing leading edge in hypersonic flight is investigated. The theory is based on a conducting plate subjected to aerodynamic heating. It is found that the role played by the conductivity of the material and the leading edge thickness in moderating the nose temperature is very significant. Detailed discussions of the numerical solutions for various shapes of leading edge are given. An experimental technique was developed by which a number of models representing a wing leading edge can be tested and the results thus obtained are compared with those predicted by the theory. Author

N71-22509*# Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.

TWO PHASE DETONATION STUDIES CONDUCTED IN 1970 Annual Report, 1 Feb. 1970 - 1 Feb. 1971

J. A. Nicholls Mar. 1971 47 p refs
(Grant NGL-23-005-336)
(NASA-CR-72868; UM-026030-2-P; AR-2) Avail: NTIS CSCL 20M

Five project phases are described separately: (1) Ignition of fuel drops by a shock wave and passage of a shock wave over a burning drop. (2) Propagation of a two phase detonation with a controlled distribution of drop size. (3) The attenuation of shock and detonation waves passing over an acoustic liner. (4) An experimental and theoretical study of film detonations. (5) A simplified analytical model of a rotating two phase detonation wave in a rocket motor. Author

N71-22534*# Israel Program for Scientific Translations, Ltd., Jerusalem.

INITIATION OF SOLID EXPLOSIVES BY IMPACT

G. T. Afanasev et al 1971 120 p refs Transl. into ENGLISH of the publ. 'Initsiirovanie Tverdykh Vzryvchatykh Veshchestv Udarom' Moscow, Nauka, 1968 Supported by NASA and NSF
(NASA-TT-F-623; TT-70-50074) Copyright. Avail: NTIS CSCL 20M

An introduction is presented to the quantitative theory of the sensitivity of solid explosives to mechanical action. Results of investigations into the mechanism of the initiation of solid explosives by impact are described. The three primary topics of discussion are: (1) critical conditions for initiation of explosion by impact, (2) the mechanism of heating explosives to critical temperatures, and (3) a quantitative approach to the sensitivity of solid explosives to mechanical action. Author

N71-22598 Advisory Group for Aerospace Research and Development, Paris (France).

MEASUREMENT TECHNIQUES IN HEAT TRANSFER

E. R. G. Eckert (Minn. Univ., Minneapolis) and R. J. Goldstein (Minn. Univ., Minneapolis), eds. Slough, Engl. Technivision Serv. Nov. 1970 521 p refs Summer course held in Minneaplis, Jun. 1968; sponsored by Minn. Univ. Extension Div.
(AGARDograph-130) Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

CONTENTS:

1. ERROR ESTIMATES IN TEMPERATURE MEASUREMENT E. M. Sparrow (Minnesota Univ., Minneapolis) p 13-32 refs (See N71-22597 11-33)

2. PRECISION RESISTANCE THERMOMETRY AND FIXED H. F. Stimson (NBS, Washington, D. C.) p 33-62 refs (See N71-22598 11-33)

3. A STUDY OF STABILITY OF HIGH TEMPERATURE PLATINUM RESISTANCE THERMOMETERS J. P. Evans and G. W. Burns (NBS, Washington, D. C.) p 63-73 refs (See N71-22599 11-14)

4. THERMOCOUPLE AND RADIATION THERMOMETRY ABOVE 900 K H. J. Kostkowski and G. W. Burns (NBS, Washington, D. C.) p 75-98 refs (See N71-22600 11-33)

5. TEMPERATURE MEASUREMENT IN CRYOGENICS J. A. Clark (Mich. Univ., Ann Arbor) p 99-176 refs (See N71-22601 11-33)

6. OPTICAL MEASUREMENT OF TEMPERATURE R. J. Goldstein (Minn. Univ., Minneapolis) p 177-228 refs (See N71-22602 11-33)

7. SPECTROSCOPIC TEMPERATURE DETERMINATION IN HIGH TEMPERATURE GASES E. Pfender (Minn. Univ., Minneapolis) p 229-267 refs (See N71-22603 11-33)

8. PROBE MEASUREMENTS IN HIGH TEMPERATURE GASES AND DENSE PLASMAS J. Grey (Greyrad Corp., Princeton, N. J.) p 269-307 refs (See N71-22604 11-33)

9. TRANSIENT EXPERIMENTAL TECHNIQUES FOR SURFACE HEAT FLUX RATES C. J. Scott (Minn. Univ., Minneapolis) p 309-328 refs (See N71-22605 11-33)

10. ANALOGIES TO HEAT TRANSFER PROCESSES E. R. G. Eckert (Minn. Univ., Minneapolis) p 329-351 refs (See N71-22606 11-33)

11. THERMAL RADIATION MEASUREMENTS D. K. Edwards (Calif. Univ., Los Angeles) p 353-396 refs (See N71-22607 11-33)

12. MEASUREMENT OF THERMOPHYSICAL PROPERTIES W. Leidenfrost (Purdue Univ., Lafayette, Ind.) p 397-440 refs (See N71-22608 11-33)

13. TRANSPORT PROPERTY MEASUREMENTS IN THE HEAT TRANSFER LABORATORY, UNIVERSITY OF MINNESOTA W. Ibele (Minn. Univ., Minneapolis) p 441-457 refs (See N71-22609 11-33)

14. FLUID VELOCITY MEASUREMENT FROM THE DOPPLER SHIFT OF SCATTERED LASER RADIATION R. J. Goldstein and D. K. Fried (Minn. Univ., Minneapolis) p 459-486 refs (See N71-22610 11-16)

15. OPERATION AND APPLICATION OF COOLED FILM SENSORS FOR MEASUREMENTS IN HIGH TEMPERATURE GASES L. M. Fingerson (Thermo-Systems, Inc., St. Paul, Minn.) and A. M. Ahmed (McGill Univ.) p 487-504 refs (See N71-22611 11-14)

N71-22597 Minnesota Univ., Minneapolis. Heat Transfer Lab.
ERROR ESTIMATES IN TEMPERATURE MEASUREMENT
E. M. Sparrow *In* AGARD Meas. Tech. in Heat Transfer Nov. 1970 p 13-32 refs (See N71-22596 11-33)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

Computational models for estimating errors in temperature measurements in fluids and in solids are described. Consideration is given to measurements performed with thermocouples and similar probes. The various analytical models include heat transfer by conduction, convection, radiation, and viscous dissipation effects. Both transient and steady state error estimates are made. Author

N71-22598 National Bureau of Standards, Washington, D.C.
PRECISION RESISTANCE THERMOMETRY AND FIXED POINTS
H. F. Stimson *In* AGARD Meas. Tech. in Heat Transfer Nov. 1970 p 33-62 refs (See N71-22596 11-33)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

Various types of resistance thermometers for precision measurements of the fixed points of the International Temperature Scale are discussed. The calibration of the instruments, the techniques used, recent developments and improved accuracy, and the remaining difficulties in precision thermometry are described. It is shown that the present triple point cells and the boilers for realizing the steam, sulfur, and oxygen points make possible accuracy comparable to that indicated in the ITS text. N.E.N.

N71-22600 National Bureau of Standards, Washington, D.C.
THERMOCOUPLE AND RADIATION THERMOMETRY ABOVE 900 K
Henry J. Kostkowski and George W. Burns *In* AGARD Meas. Tech. in Heat Transfer Nov. 1970 p 75-98 refs (See N71-22596 11-33)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The principles of thermocouple and radiation thermometry above 900 K, the present day precision and accuracy, and the commercial instruments currently available are reviewed. The International Practical Temperature Scale and the Thermodynamic Kelvin Temperature Scale are briefly described. With regard to thermocouples, the presentation is confined to the more generally accepted base, noble, and refractory metal types. Characteristics such as temperature range, stability, and environmental limitations are emphasized. The optical pyrometry discussion includes emittance corrections, recommendations for using visual optical pyrometers, and the status of the photoelectric optical pyrometers. Finally, two-color, three-color and total-radiation pyrometers are discussed, primarily to show that, in spite of the recent interest in these instruments, they are not generally as suitable for measuring temperature as optical (single-color) pyrometers. Author

N71-22601 Michigan Univ., Ann Arbor.
TEMPERATURE MEASUREMENT IN CRYOGENICS
John A. Clark *In* AGARD Meas. Tech. in Heat Transfer Nov. 1970 p 99-176 refs (See N71-22596 11-33)
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Basic principles and the practical considerations of temperature measurement in the cryogenic range, i.e., below -150 C, are considered. The following topics are included: the concept of temperature; the absolute thermodynamic temperature scale; the gas thermometer; the International Practical Temperature Scale; temperature scales below 90 K; thermo-electric devices; resistance thermometers including platinum resistance elements, carbon resistors, thermistors, and germanium thermometers; and magnetic thermometry or adiabatic demagnetization. Author

N71-22602 Minnesota Univ., Minneapolis.
OPTICAL MEASUREMENT OF TEMPERATURE
R. J. Goldstein *In* AGARD Meas. Tech. in Heat Transfer Nov. 1970 p 177-228 refs (See N71-22596 11-33)
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Shadowgraph, schlieren, and interferometric systems are described. The physical principles of the three methods are reviewed and the equations necessary to evaluate density and temperature fields are derived. Design problems and the ranges of application are indicated with examples. Errors which affect the evaluating equations are considered including quantitative corrections which can be used. The application of lasers to some optical measuring systems is discussed. Author

N71-22603 Minnesota Univ., Minneapolis.
SPECTROSCOPIC TEMPERATURE DETERMINATION IN HIGH TEMPERATURE GASES
E. Pfender *In* AGARD Meas. Tech. in Heat Transfer Nov. 1970 p 229-267 refs (See N71-22596 11-33)
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The various physical laws and definitions of gaseous radiation are reviewed including the different types of radiation which are emitted by a high temperature gas. The most important direct and indirect spectrometric methods for temperature measurements of emitting-absorbing high temperature gases are discussed. Author

N71-22604 Greyrad Corp., Princeton, N. J.
PROBE MEASUREMENTS IN HIGH TEMPERATURE GASES AND DENSE PLASMAS
Jerry Grey *In* AGARD Meas. Tech. in Heat Transfer Nov. 1970 p 269-307 (See N71-22596 11-33) refs
Copyright. Avail: Technivision, Braywick House, Maidenhead,

Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

Water-cooled or gas-cooled probes are capable of measuring a number of gas and flow properties continuously under conditions of extremely high heat transfer. These probes can measure, in various combinations, gas enthalpy, composition, velocity, Mach number, temperature (both atom or ion and electron temperatures in plasmas), electron density, degree of ionization, heat transfer rate, high frequency pressure oscillations, scale and intensity of turbulence (in plasmas), and steady state static and impact pressures. Typical conditions under which these steady-state measurements may be made are: gas temperatures over 17,000 K; heat flux levels up to 50 Btu/sq in.-sec; Mach numbers up to 25; stagnation pressures up to 150 atmospheres; temperature gradients up to 20,000 K/cm. Accuracy levels as high as + or - 1 percent have been achieved. Author

N71-22605 Minnesota Univ., Minneapolis.
TRANSIENT EXPERIMENTAL TECHNIQUES FOR SURFACE HEAT FLUX RATES
C. J. Scott *In* AGARD Meas. Tech. in Heat Transfer Nov. 1970 p 309-328 refs (See N71-22596 11-33)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The available techniques for measuring surface heat flux rates are described. For microsecond duration experiments the thin film thermometer and thick film calorimeter are attached to the surface under investigation. For longer testing times, the heat capacity of the surface itself is employed as the calorimeter. A few of the exact solutions are given along with graphed time-temperature curves which may be used to infer heat flux rates from transient temperature measurements. Author

N71-22606 Minnesota Univ., Minneapolis. School of Mechanical and Aerospace Engineering.
ANALOGIES TO HEAT TRANSFER PROCESSES
E. R. G. Eckert *In* AGARD Meas. Tech. in Heat Transfer Nov. 1970 p 329-351 refs (See N71-22596 11-33)
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After a short discussion of analogies to conductive and radiative heat transfer, analogies describing convective heat transfer situations are emphasized. Mass transfer analogies are described for constant property and variable property fluids. The electrochemical method of simulating heat transfer in liquids to measure local mass transfer coefficients, and an electrochemiluminescence variation is mentioned. N.E.N.

N71-22607 California Univ., Los Angeles.
THERMAL RADIATION MEASUREMENTS
D. K. Edwards *In* AGARD Meas. Tech. in Heat Transfer Nov. 1970 p 353-396 refs (See N71-22596 11-33)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

Measurement techniques for determining radiant energy fluxes and radiation characteristics of materials are reviewed. A convenient operator and matrix notation together with a consistent nomenclature is set forth to facilitate understanding of what an instrument really measures. Radiometry, surface characteristic measurements, and gas property measurements are considered. Attention is focused on spectral directional reflectance measurements with heated cavity, integrating sphere, and 2 pi-steradian mirror reciprocal reflectometers. Problems encountered in radiation measurements are shown to be largely avoidable by careful formulation of the measured quantity using the notation propounded. Author

N71-22608 Purdue Univ., Lafayette, Ind. School of Mechanical Engineering.
MEASUREMENT OF THERMOPHYSICAL PROPERTIES
W. Leidenfrost *In* AGARD Meas. Tech. in Heat Transfer Nov. 1970 p 397-440 refs (See N71-22596 11-33)
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Techniques used in the measurements of thermophysical properties are described. A selection was made of those which appear to provide the most detailed and clear descriptions. General methods for determining viscosity, thermal conductivity, and specific heats are discussed, and the most commonly used apparatus and approaches necessary to achieve reliable data are illustrated. Author

N71-22609 Minnesota Univ., Minneapolis. Dept. of Mechanical Engineering.
TRANSPORT PROPERTY MEASUREMENTS IN THE HEAT TRANSFER LABORATORY, UNIVERSITY OF MINNESOTA
W. Ibele *In* AGARD Meas. Tech. in Heat Transfer Nov. 1970 p 441-457 refs (See N71-22596 11-33)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

Experimental methods are described for measuring properties important for heat transfer calculations. One scheme takes the flat plate boundary layer equation solution for recovery factor as a basis for determining the dimensionless heat transfer quantity Prandtl number. Another method uses phenomena noted during transpiration heat transfer measurements to design an optimum test chamber and probe to measure diffusion properties. In a third instance, the familiar cylindrical geometry is taken to the limit of a very small central wire serving both as heat source and resistance thermometer to measure gas thermal conductivities. Author

N71-22625*# AiResearch Mfg. Co., Los Angeles, Calif.
AN ANALYTICAL STUDY OF HYDROGEN COOLED PANELS FOR APPLICATION TO HYPERSONIC AIRCRAFT
W. G. Flieder, C. E. Richard, O. A. Buchmann, and F. M. Walters Washington NASA Apr. 1971 201 p refs
(Contract NAS1-5002-1)
(NASA-CR-1650; Rept-68-3667) Avail: NTIS CSCL 20M

Results of an engineering design study of flat, hydrogen-cooled, structural panels for heat fluxes up to 500 Btu/sec-sq ft and pressure loads up to 250 psi are presented. Three basic conceptual designs, with varying degrees of integration of the thermal protection and structural functions of the panel, are evolved; minimum panel weights are obtained; and the ranges of applicability of the various concepts are established. Detailed procedures used to analyze and optimize panel design are included. Author

N71-22632 Institut Franco-Allemand de Recherches, St. Louis (France).
SHOCK INDUCED COMBUSTION BY HIGH SPEED SHOTS IN EXPLOSIVE GAS MIXTURES
H. Behrens, H. Lehr, W. Struth, and F. Wecken *In* AGARD New Exptl. Tech. in Propulsion and Energetics Res. Oct. 1970 p 151-163 refs (See N71-22626 11-12)
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Shock-induced combustion phenomena were studied by firing spheres or cone-cylinders into mixtures of hydrogen with air or with oxygen and taking shadow photographs of the disturbances they created. The tests were carried out at pressures of 0.24 to 0.72 atm and velocities up to 2900 m/s. The missiles of 9 mm calibre of the earlier experiments were fired without spin, later cone-cylinder configurations of 15 mm calibre were spin-stabilised.

Among the topics studied were the relative amount of heat added to the flow, ignition temperatures and boundary layer combustion. Experiments with cone-boattail configurations show separation of flow. This is explained by the generation of a pressure increase in the flow direction because of the addition of heat by combustion in supersonic flow. The implications for hypersonic propulsion with external burning are considered. An outlook is given on the theory of conical flow with heat addition in the shock front neglecting real gas effects. Author

N71-22641 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
TEMPERATURE MEASUREMENT OF HIGH ENTHALPY FLOW [SONDE DE TEMPERATURE POUR ECOULEMENT A HAUTE ENTHALPIE]
D. Gautrot *In* AGARD New Exptl. Tech. in Propulsion and Energetics Res. Oct. 1970 p 357–366 refs In FRENCH; ENGLISH summary (See N71-22626 11-12)
Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The stagnation temperature of combustion gases is determined by means of a chromel-alumel thermocouple which can be cooled by an air flow. The rate of temperature increment is recorded during the brief duration of noncooling. The equilibrium temperature is determined with an analogue computer; the time of measurement is about 1 second. Author

N71-22697*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INVESTIGATION OF FLAMELESS COMBUSTION MECHANISM OF M-2 DOUBLE BASE PROPELLANT
Cecil Eugene Kirby Washington Apr. 1971 27 p refs
(NASA-TN-D-6105; L-7346) Avail: NTIS CSCL 21B

An experimental study of the heat of reaction for the flameless combustion of M-2 double base propellant (20 percent nitroglycerin, 77 percent nitrocellulose, 3 percent other ingredients) at pressures from 2.07 to 1380 kN/sq m has been performed by use of differential scanning calorimetry and thermogravimetric analysis. The heat of reaction varied from 1.17 MJ/kg at 2.07 kN/sq m to 3.02 MJ/kg at 1380 kN/sq m with abrupt changes occurring near 13.8 kN/sq m, 138 kN/sq m, and 689 kN/sq m. The jumps in heat of reaction occurred at pressures corresponding to jumps in the burning rate and temperature jumps in the gas phase. On the basis of these results and the usual construction of a differential scanning calorimeter (DSC), it is concluded that the DSC is inadequate for measurements of the condensed-phase heat of reaction of double base propellants, since the heat produced by these gas phase reactions so close to the surface would also be detected by the instrument heat sensing system. Comparison of differential scanning calorimeter and thermogravimetric analysis data shows that the desorption/vaporization of nitroglycerin occurs near the onset of significant heating and that no heating occurs before weight loss begins. This result implies that pure condensed phase contributions are minor for M-2 double base propellant in the flameless combustion region. Author

N71-22708 Iowa State Univ. of Science and Technology, Ames.
THE CHEMICAL THERMODYNAMICS OF OSCILLATORY COMBUSTION
Arthur William Opsahl (Ph.D. Thesis) 1969 145 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 70-7728

The kinetic rate equations which apply to the combustion of certain hydrocarbons were solved approximately to yield information that is difficult to obtain experimentally. Computer programs were developed which may be used to calculate the equilibrium composition of a general mixture of gases. The programs are kinetics free and operate by minimizing the total free energy of the mixture. The programs were used to provide equilibrium data over a wide range of temperatures and mixture ratios for both constant pressure processes and constant volume processes. Approximate integration techniques were developed which permit the solution of the set of simultaneous kinetic rate equations which describe the oscillatory combustion of hydrocarbons. The dynamic concentrations for each chemical species were calculated as a function of time and position in a model combustor. Three combustion systems were investigated: the combustion of carbon monoxide in oxygen, the combustion of carbon monoxide in air, and the products of the combustion of methane in air. Dissert. Abstr.

N71-22709 North Carolina State Univ., Raleigh.
THE THERMAL TRANSPIRATION EFFECT IN LONG TUBES
James Alvin Daggerhart, Jr. (Ph.D. Thesis) 1969 77 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 70-9177

The results are presented of an experimental investigation of the pressure difference induced across a stainless steel capillary by a temperature gradient along the capillary. The absolute pressure levels involved in these experiments ranged from 1 torr to 0.00001 torr to provide both continuum and free molecular conditions relative to the capillary tube. All experimental tests were performed with a helium atmosphere to avoid gas condensation and allow free molecular flow to be obtained at pressures easily within the range of the experimental apparatus. Comparison of the results with Liang's empirical equation indicates that this relation may be employed to predict the thermal transpiration effect in stainless steel capillary tubes using the orifice limit as the free molecular bound. Based on Liang's equation, correction charts are presented for the thermal transpiration effect. Other factors affecting pressure measurement systems, such as response times and outgassing, are also discussed. Dissert. Abstr.

N71-22715*# Martin Marietta Corp., Denver, Colo.
PAET AFTERBODY THERMAL PERFORMANCE AND COMPONENT MECHANICAL PROPERTIES
David L. Carlson Apr. 1971 57 p refs
(Contract NAS2-6274)
(NASA-CR-114293) Avail: NTIS CSCL 20M

The results are presented of an investigation conducted on the Planetary Atmospheric Experiments Test (PAET) ablative afterbody. The specific tasks involved in the study include: (1) calculation of the thermal response of the PAET afterbody ablator/structure and of the afterbody/forebody interface region; (2) fabrication and test of SLA-220-ablator/PAET structure plasma arc specimens; and (3) the experimental determination of the PAET afterbody component structural properties. Author

N71-22791 Purdue Univ., Lafayette, Ind.
RESIDUAL GAS CONDUCTION AND RADIATION NEAR LIQUID HELIUM TEMPERATURE
Francis William Pirtle, III (Ph.D. Thesis) 1969 277 p
Avail: Univ. Microfilms: HC $12.60/Microfilm $3.60 Order No. 70-8948

Residual gas conduction and radiation heat transfer were investigated for temperatures near the normal boiling temperature of helium. The combined heat transfer between concentric cylinders was measured as a function of the pressure of helium gas in the space between the cylinders. A calorimetric technique is used. The temperature of the inner cylinder varies between 8.8 K and 5.2 K. The outer cylinder temperature is 4.2 K. The temperature change of the inner cylinder is used to determine the amount of heat transferred. A theoretical equation and computer program are developed to closely simulate the experimental test for residual gas conduction. The change of heat capacity with temperature is included in the program. By comparing the experimental and

theoretical results at helium gas pressures large enough for radiation to be negligible compared to residual gas conduction, the accommodation coefficient of the helium gas-cylinder surfaces can be determined. Dissert. Abstr.

N71-22782* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THERMAL CONTROL WALL PANEL Patent
William J. O'Sullivan, Jr., inventor (to NASA) Issued 21 May 1968 (Filed 28 Mar. 1966) 6 p Cl. 244-1
(NASA-Case-XLA-01243; US-Patent-3,384,324; US-Patent-Appl-SN-538911) Avail: US Patent Office CSCL 20M

A thermosensitive wall panel is described for use in the temperature control of enclosed structures subjected to a variable electromagnetic radiation environment. The panel is designed to achieve a controllable solar absorptivity/thermal emmissivity ratio of the enclosure and, in this way, provide a means for regulating an entire spacecraft or any portion of it, within desired limits. D.L.G.

N71-22879 Purdue Univ., Lafayette, Ind.
THE SPECIFIC HEAT OF RHENIUM BETWEEN 0.15 AND 4.0 K
David Reeder Smith (Ph.D. Thesis) 1969 67 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 70-8973

The specific heat of rhenium was measured in the normal state between 0.15 and 4.0 K and in the superconducting state between 0.3 and 4.0 K. The motivation was to investigate the Schottky anomaly in the specific heat due to the interaction of the nuclear quadrupole moment with the crystalline field, for a high-purity (99.995%) specimen. The critical field parameter H sub o was found to be 210 oersteds, and the deviation of the critical field curve from parabolic dependence was less than 3.8%. The resonant frequencies corresponding to the interaction between the nuclear quadrupole moment with the crystalline field were found to be 41 and 82 MHz. Dissert. Abstr.

N71-22890* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THERMAL CONTROL PANEL Patent
William J. O'Sullivan, Jr., inventor (to NASA) Issued 26 Mar. 1968 (Filed 28 Mar. 1966) 6 p Cl. 165-96
(NASA-Case-XLA-07728; US-Patent-3,374,830; US-Patent-Appl-SN-538908) Avail: US Patent Office CSCL 20M

The construction of a thermo-sensitive panel for temperature control of spacecraft is described. The laminated panel absorbs in whole or in part incident electromegnetic radiation until the wall temperature attains the desired temperature at which point its changeable physical property characteristics cause the wall to become reflective to the incident electromagnetic radiation. In this manner the wall temperature is automatically stabilized at the design temperature level. Official Gazette of the U.S. Patent Office

N71-23000*# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
APPRAISAL OF UTIAS IMPLOSION DRIVEN HYPERVELOCITY LAUNCHERS AND SHOCK TUBES
I. I. Glass Jun. 1970 69 p refs Sponsored in part by Can. Natl. Res. Council, Defence Res. Board, and Dept. of Defence Production
(Grant NGR-52-026-023; Contract AF 33(615)-5313) (NASA-CR-117856; UTIAS-31) Avail: NTIS CSCL 19A

A critical appraisal is made of the design, research, development, and operation of the UTIAS implosion-drive hypervelocity launchers and shock tubes. Explosively driven (PbN6 and PETN) implosions in detonating stoichiometric hydrogen-oxygen mixtures were successfully developed as drivers for hypervelocity launchers and shock tubes in a safe and reusable facility. Intense loadings at very high calculated pressures (almost megabar range), densities (g/cu cm) and temperatures (thousands K), at the implosion center, cause severe problems with projectile integrity. Misalignment of the focal point can occur and add to the difficulty in using small caliber (6 to 8 mm dia) projectiles. In addition, the extreme driving conditions cause barrel expansion, erosion, and possible gas leakage from the base to the head of the projectile which cut the predicted muzzle velocities to half or a third of the lossless calculated values. However, in the case of a shock tube operation these difficulties are minimized or eliminated and the possibilities of approaching Jovian reentry velocities are encouraging. Author

N71-23066* National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
HEAT FLUX MEASURING SYSTEM Patent
Richard D. Baxter, inventor (to NASA) Issued 6 Feb. 1968 (Filed 2 Jun. 1965) 4 p Cl. 73-190
(NASA-Case-XFR-03802; US-Patent-3,367,182; US-Patent-Appl-SN-460877) Avail: US Patent Office CSCL 20M

A heat flux sensor is described which is adapated for mounting on research aircraft for determining the aerodynamic heat flux inflow to the skin of an aircraft or space vehicle. The thermally symmetrical rod-shaped sensor is mounted flush with the aerodynamic surface and is well insulated from the surrounding environment. The sensor includes a heating circuit that detects thermal differentials between the skin and exposed end of the sensor and raises the exposed-end temperature to the skin temperature; a heating circuit that detects temperature differentials between the insulated and exposed ends of the sensor; and a heater power input monitoring device. J.M.

N71-23100*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MASS DIFFUSIVITY EFFECTS ON DROPLETS IN FILM BOILING
Glen J. Schoessow (Fla. Univ., Gainesville) and Kenneth J. Baumeister [1971] 17 p refs Proposed for presentation at 12th Natl. Heat Transfer Conf., Tulsa, Okla., 15-18 Aug. 1971; sponsored by ASME and Am. Inst. of Chem. Engr.
(NASA-TM-X-67808) Avail: NTIS CSCL 20M

Experimental film boiling data for water droplets vaporizing into air, argon, nitrogen, helium, and steam are presented. A dimensionless grouping is presented which compares vapor removal by diffusion from the top of the drop to vapor removal by film boiling from the bottom of the drop. This dimensional grouping is in good agreement with the experimental data. Author

34 GENERAL

Includes information of a broad nature related in industrial applications and technology, and to basic research; defense aspects; information retrieval; management; law and related legal matters; and legislative hearings and documents.

N71-21875# Westinghouse Electric Corp., East Pittsburgh, Pa. Transportation Div.
SATELLITE TRANSIT FOR SEATTLE-TACOMA AIR TRAVELLERS IN 1980 AND BEYOND
E. E. Hogwood, Jr. and H. W. Lindell (The Richardson Associates) 1970 23 p Presented at the 6th IEEE Regional Conf., Seattle, 26 May 1970
Avail: NTIS

An underground transportation system for the airport serving the Seattle-Tacoma, Washington area is described. The transit

system will make stops at six stations located in the terminal building and will be available for boarding at 100 second intervals.
Author

N71-22026*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SYSTEMS MANAGEMENT TECHNIQUES AND PROBLEMS
1 Feb. 1971 136 p refs Presented at the Systems Management Conf. (SM70), Los Angeles, 31 Mar. – 2 Apr. 1970
(NASA-TM-X-64575) Avail: NTIS CSCL 05A

CONTENTS:

1. HISTORY AND TRENDS OF SYSTEMS ENGINEERING R. W. Hovey (TRW Sys. Group, Redondo Beach, Calif.) p 1–12 refs (See N71-22027 11-34)

2. SYSTEMS MANAGEMENT AND COMMON SENSE O. C. Boileau (Boeing Co., Seattle, Wash.) p 13–19 refs (See N71-22028 11-34)

3. SYSTEM ENGINEERING ARMY STYLE J. M. Rickhind (Army Materiel Command, Washington, D.C.) p 20–30 ref (See N71-22029 11-34)

4. BARRIERS TO RATIONALITY IN SYSTEMS MANAGEMENT J. Klimberg (JPL, Calif. Inst. of Tech., Pasadena) p 31–46 refs (See N71-22030 11-34)

5. SUBTLETIES OF SATURN SYSTEM ENGINEERING M. A. Cutchins (Auburn Univ., Ala.) p 47–57 refs (See N71-22031 11-34)

6. THE REVELATION OF SATURN-APOLLO S. E. McCrary p 58–63 (See N71-22032 11-34)

7. EDUCATIONAL SYSTEM MANAGEMENT: PREMISES, PROBLEMS, PROGRESS, AND PORTENT Le Roy R. Rosen (Rosen Assoc., Woodland Hills, Calif.) p 64–72 (See N71-22033 11-34)

8. SYSTEM MANAGEMENT APPLIED TO WATER RESOURCE DEVELOPMENT PLANNING A. R. Golze (Calif. Dept. of Water Resources) p 73–84 refs (See N71-22034 11-34)

9. SYSTEMS CONSIDERATION IN COASTAL ZONE MANAGEMENT J. J. Moore (Modern Management) p 85–92 refs (See N71-22035 11-34)

10. CROWNING OF A QUEEN M. M. Wolff (Harco Engineering) p 93–99 refs (See N71-22036 11-34)

11. CAN SYSTEMS MANAGEMENT REALLY SAVE MEDICINE? N. P. Thompson (Plato Alto Med. Res. Foundation, Calif.) p 100–106 ref (See N71-22037-11-34)

12. MANAGEMENT INFORMATION SYSTEMS FOR RETAIL INVENTORY MANAGEMENT B. Codner (Calif. State Coll., Los Angeles) p 107–117 (See N71-22038 11-34)

N71-22027*# TRW Systems Group, Redondo Beach, Calif. Design and Integration Lab.
HISTORY AND TRENDS OF SYSTEMS ENGINEERING
Robert W. Hovey *In* NASA. Marshall Space Flight Center Systems Management Tech. and Probl. 1 Feb. 1971 p 1–12 refs (See N71-22026 11-34)
Avail: NTIS CSCL 05A

The evolution of systems engineering is outlined as an effective methodology and technique serving as a critical element in the technical development of large complex high-performance systems that were completed within tight schedule constraints. Flexibility in adapting procedures (through innovation, transfer, and translation) combined with firmness in meeting objectives and requirements are discussed as two important characteristics that have contributed to the successful and effective applications of systems engineering. The trends continue for the development of better understanding of the nature of the systems engineering process and for the acquisition of additional experience in the application of systems engineering methodology as a factor in the civil sector of activity. Author

N71-22028*# Boeing Co., Seattle, Wash. Missile Div.
SYSTEMS MANAGEMENT AND COMMON SENSE
O. C. Boileau *In* NASA. Marshall Space Flight Center Systems Management Tech. and Probl. 1 Feb. 1971 p 13–19 refs (See N71-22026 11-34)
Avail: NTIS CSCL 05A

Systems management and management techniques are discussed as the manager's disciplined common sense. Two techniques are used to illustrate coordination and planning. Systems, management, and systems management are summarized as well as decision making. J.M.

N71-22029*# Army Materiel Command, Washington, D.C.
SYSTEM ENGINEERING ARMY STYLE
Joseph M. Rockhind *In* NASA. Marshall Space Flight Center Systems Management Tech. and Probl. 1 Feb. 1971 p 20–30 ref (See N71-22026 11-34)
Avail: NTIS CSCL 05A

Reasons for the introduction of system engineering into the weapon acquisition process are outlined. A detailed procedure for Army style system engineering is summarized including function analysis, system configuration, and performance requirements. System engineering is discussed as a management tool and related to a life cycle management model. The concept is applied to a project managed system and includes a fullscale contract definition phase with development and production accomplished by industrial contractors. Technical performance measurement is discussed including identification of performance parameters, tracking and reporting of status, and problem analysis and forecasting. J.M.

N71-22030*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
BARRIERS TO RATIONALITY IN SYSTEMS MANAGEMENT
J. Klimberg *In* NASA. Marshall Space Flight Center Systems Management Tech. and Probl. 1 Feb. 1971 p 31–46 refs (See N71-22026 11-34)
Avail: NTIS CSCL 05A

Some of the barriers to rationality which seriously constrain systems management are discussed including mismanagement of hidden assumptions, blurring the education-selling interface, the use of incompatible models of leadership styles, the use of the conventional wisdom that business ethics should be different from society's ethics, and overly optimistic attitudes concerning the validity of systems analyses. Examples which characterize a few of the more persistent obstacles to rationality in decision making are presented.
J.M.

N71-22031*# Auburn Univ., Ala.
SUBTLETIES OF SATURN SYSTEM ENGINEERING
Malcolm A. Cutchins *In* NASA. Marshall Space Flight Center Systems Management Tech. and Probl. 1 Feb. 1971 p 47–57 refs (See N71-22026 11-34)
Avail: NTIS CSCL 05A

Influential management factors in the application of the systems approach to Saturn systems management are summarized. A defined goal with a definite time frame of accomplishment and technical specialist's strength are cited as the most important factors. Leadership and experience, inherent motivation of the space program, automatic responsibility, and all success planning are included in technical specialists' strength as well as flexibility of organization, visibility, and communication and openness. The transfer of the Saturn success attributes to others through NASA/ASEE programs is discussed. J.M.

N71-22032*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE REVELATION OF SATURN-APOLLO
Samuel E. McCrary *In its* Systems Management Tech. and Probl.

1 Feb. 1971 p 58–63 (See N71-22026 11-34)
Avail: NTIS CSCL 05A

The attitudes and philosophies of government and industrial management personnel which developed through work on Saturn-Apollo projects are discussed. Management techniques and team work are emphasized as well as the feeling of success before accomplishment. The management of nonreplenishable resources for sustaining human life in Apollo command modules is compared to the management of those on earth including environmental pollution and the ecological system of the future. J.M.

N71-22033*# Rosen Associates, Woodland Hills, Calif.
EDUCATIONAL SYSTEM MANAGEMENT: PREMISES, PROBLEMS, PROGRESS, AND PORTENT
Le Roy R. Rosen *In* NASA. Marshall Space Flight Center Systems Management Tech. and Probl. 1 Feb. 1971 p 64–72 (See N71-22026 11-34)
Avail: NTIS CSCL 05A

The challenge to systems management in education is discussed citing educational devices, methods, and techniques leading toward a maximally effective, responsive, and economic system for learning. The technology revolution including changes in curriculum structure; educator preparation; grading; scheduling; and computer assistance in instructor utilization, facility design, educational technology, and administration are mentioned. J.M.

N71-22034*# California State Dept. of Water Resources, Sacramento.
SYSTEM MANAGEMENT APPLIED TO WATER RESOURCE DEVELOPMENT PLANNING
Alfred R. Golze *In* NASA. Marshall Space Flight Center Systems Management Tech. and Probl. 1 Feb. 1971 p 73–84 refs (See N71-22026 11-34)
Avail: NTIS CSCL 05A

System engineering is discussed as a management tool for water resource development planning in California. The utilization of system management in interfacing a series of hydraulic basin subsystems into a master water resource system is summarized. J.M.

N71-22035*# Modern Mangement, Beverly Hills, Calif.
SYSTEMS CONSIDERATION IN COASTAL ZONE MANAGEMENT
J. Jamison Moore *In* NASA. Marshall Space Flight Center Systems Management Tech. and Probl. 1 Feb. 1971 p 85–92 refs (See N71-22026 11-34)
Avail: NTIS CSCL 05A

Systems management and control of demographic and technological change within the coastal zones of the United States are discussed. Federal and state programs and legislation are cited as well as the diversity of uses and needs of coastal zones including offshore waste disposal, marine recreation, and national security. The expanding requirements for use of a geographically limited resource are creating the economics of scarcity within the coastal regions. Economic benefits, environmental problems, and low-density uses of the land are summarized. J.M.

N71-22036*# Harco Engineering, Terminal Island, Calif.
CROWNING OF A QUEEN
Marvin M. Wolff (City of Long Beach, Calif.) *In* NASA. Marshall Space Flight Center Systems Management Tech. and Probl. 1 Feb. 1971 p 93–99 refs (See N71-22026 11-34)
Avail: NTIS CSCL 05A

Some of the Queen Mary project, management and planning problems encountered by the Long Beach, California city government are summarized. J.M

N71-22037*# Palto Alto Medical Research Foundation, Calif.
CAN SYSTEMS MANAGEMENT REALLY SAVE MEDICINE?
Noel P. Thompson *In* NASA. Marshall Space Flight Center Systems Management Tech. and Probl. 1 Feb. 1971 p 100–106 ref (See N71-22026 11-34)
Avail: NTIS CSCL 05A

Systems management techniques and their applications in the medical field are discussed. Computer applications are cited including electrocardiographic diagnosis, medical and hospital data processing, physical examinations, automatic control of therapeutic agents, and hospital design and operation. Data processing by television is also mentioned as well as patient logistics. J.M.

N71-22038*# California State Coll., Los Angeles.
MANAGEMENT INFORMATION SYSTEMS FOR RETAIL INVENTORY MANAGEMENT
Bernard Codner *In* NASA. Marshall Space Flight Center Systems Management Tech. and Probl. 1 Feb. 1971 p 107–117 (See N71-22026 11-34)
Avail: NTIS CSCL 05A

The primary objectives of information systems for retail inventory management, computerized or manual, are outlined including providing data to merchandising personnel so that they can detect trends, comparing performance against prior established goals, and ascertaining the reasons for undue deviations from plan so that remedial actions can be instituted. The development of an information system for inventory management is discussed taking into account the nature of the retailer's operations, the merchandising philosophies that guide these activities, and the work habits and preferences of those responsible for inventory management. The mix of a store's staple, fashion, and big ticket merchandise is characterized and the information requirements for inventory management of the three types of stock are summarized. J.M.

N71-22185# Royal Swedish Academy of Engineering Sciences, Stockholm.
A SYNTAX TO FORMALIZE LINGUISTIC INFORMATION
Erik Sundstroem 1970 25 p refs Sponsored by Swed. Council for Sci. Inform. and Doc.
(IVA-25) Avail: NTIS

Several activities in the information processing field are connected with some sort of unique data representation of what is known as the semantic contents of linguistic expression. In information retrieval this is seen to be the case when a search query is assigned groups of words with certain logical relations to each other. It is wondered whether these relations can be successfully replaced by categories that are extracted in some mechanical fashion from the query itself and whether the same categories be made into an instrument to extract other words of value for the continued search from a given set of contexts. These and allied problems are considered as suitable testing grounds for a syntactic description of natural language, a description which is designed as a means to formalize linguistic information efficiently enough to meet the requirements of information retrieval. The proposed syntax is a simple structure that every sentence of the language is supposed to satisfy. The steps that constitute the would-be mechanical analysis are only described in general terms. The purpose of the paper is to establish the necessity of experiments and to point out how these may be carried through. Author (ESRO)

N71-22405# National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.
METHODS FOR THE ALLEVIATION OF SHIP ICING
J. R. Stallabrass Aug. 1970 37 p refs
(NRC-11872; MD-51) Avail: NTIS

Tests were made, both in an icing wind tunnel and at an outdoor test site, of various proposals for the alleviation of the

problem caused by the freezing of sea spray on the superstructures of ships. Of the devices evaluated, a pneumatic de-icing technique proved the most effective under all conditions for the de-icing both of masts and of flat surfaces such as bridge fronts. Next in effectiveness was the use of ethylene glycol as a freezing point depressant to reduce the strength and adhesion of the ice. Several passive methods were tried, but none were very effective, with the exception of a plastic foam with an outer layer of neoprene rubber.
Author

N71-22487# Committee on Aeronautical and Space Sciences (U.S. Senate).
NOMINATION ON THE NOMINATION OF DR. JAMES C. FLETCHER TO BE ADMINISTRATOR OF THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Washington GPO 1971 25 p refs Hearing before Comm. on Aeron. and Space Sci., 92d Congr., 1st Sess., 10 Mar. 1971
Avail: Comm. on Aeron. and Space Sci.

Testimony in support of the nominee as Administrator of NASA is given, including a brief history of past achievements, honors, and qualifications. The candidate's views on present and future plans for NASA programs are also presented. J.A.M.

N71-22489# Committee on Aeronautical and Space Sciences (U.S. Senate).
NUCLEAR ROCKET ENGINE DEVELOPMENT PROGRAM
Washington GPO 1971 139 p Joint Hearings before Comm. on Aeron. and Space Sci. and Joint Comm. on At. Energy, 92d Congr., 1st Sess., 23–24 Feb., 1971
Avail: Comm. on Aeron. and Space Sci.

The hearings concerning the nuclear rocket engine development program are reported. Subjects discussed include resources requirements, AEC nuclear rocket funding, NASA budget plan, manpower reductions, and loss of skilled people. F.O.S.

N71-22819# Israel Program for Scientific Translation, Ltd., Jerusalem.
GOING TO THE ARCTIC BY LENIN'S DECREE
M. I. Belov *In its* Probl. of the Arctic and the Antarctic 1970 p 143–147 refs (See N71-22801 11-13)
Copyright. Avail: NTIS HC$6.00/MF$0.95

A brief historical review is presented of Soviet exploration in the Arctic since 1918 and the important role played by Lenin in the launching of scientific investigation and transformation of the northern regions. A.L.

N71-22850# Israel Program for Scientific Translation, Ltd., Jerusalem.
ALASKA POPULATION DYNAMICS: A REVIEW OF THE LITERATURE
A. O. Sphaikher *In its* Probl. of the Arctic and the Antarctic 1970 p 372–376 refs (See N71-22801 11-13)
Copyright. Avail: NTIS HC$6.00/MF$0.95

Alaska was divided into five regions for statistical comparisons. The demarcation of these regions was based on climatic, physiographic, natural, and economic conditions. Tables were prepared showing: (1) population distribution in each of the five regions as of 1 April 1960; (2) population variation with time from 1740 to 1967; and (3) mortality rate from 1950 through 1963. A.L.

N71-22898# Committee on Commerce (U. S. Senate).
REORGANIZATION PLAN 4 OF 1970 TO CREATE A NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION IN THE DEPARTMENT OF COMMERCE
Washington GPO 1970 20 p refs Hearings before Comm. on Com., 91st Congr., 2d Sess., 27 Jul. 1970
Avail: Subcomm. on Oceanog.

Testimony is reported in support of the reorganization plan as presented by the Under Secretary, Department of Commerce; the Assistant Secretary, Science and Technology; the Deputy Administrator of ESSA; and the Special Assistant to the Secretary for Policy Development. E.C.

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The proceedings of a conference held at NASA's Lewis Research Center, Cleveland, Ohio, November 18–19, 1970. As the title implies, the subject of modern-day aircraft propulsion was covered rather thoroughly. *Paperbound.* 472 pp. Available from the National Technical Information Service, Springfield, Va. 22151, for $6.00.

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